Tampere University

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Social Exclusion and Responses to Eye Gaze

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ABSTRACT

Eye gaze is one of the most important cues to convey social exclusion and social inclusion. In the present thesis, socially excluded and socially included individuals' responses to others' eye gaze were investigated in three empirical studies (Studies I-III). The empirical studies were complemented by a literature review taking a broader look into how exclusion modulates processing of social information more generally (Study IV).

The aim of Study I was to examine whether viewing direct gaze would ameliorate affective distress after exclusion. Two experiments found no evidence for this. Socially excluded participants showed similar levels of recovery of basic social needs between two measurement stages regardless of whether they viewed a video of a person portraying direct or downward gaze between the stages. Study II investigated how exclusion and inclusion in an online interaction modulate gaze direction judgments. The results showed that, when compared to inclusion and non-social control groups, socially excluded participants judged a narrower range of gaze directions as being pointed at them, possibly reflecting avoidance motivation. No differences in gaze direction judgments between inclusion and non-social control groups were found. Study III tested whether exclusion or inclusion would delay disengagement of attention from faces portraying direct gaze. Contrary to the hypotheses, only the social inclusion group showed delayed disengagement from direct gaze faces, as compared to downward gaze faces. Social exclusion and non-social control groups responded similarly, showing no differences in disengagement of attention from faces portraying direct and downward gaze.

A literature review in Study IV revealed that exclusion modulates several social cognitive processes. Exclusion alters evaluation of social information and allocation of attention towards social stimuli. These changes may be different depending on various individual traits and situational factors. Exclusion also improves memory for socially relevant information and even enhances social information processing at early processing stages, such as enhancing facial expression recognition. Importantly, however, several important gaps in the literature were identified, such as that previous research had not paid close attention to investigating the mechanisms mediating the effects of exclusion on various cognitive functions involving processing of social information. Directions for future research were proposed.

TIIVISTELMÄ

Katse on yksi tärkeimmistä signaaleista, joilla ihminen viestii ryhmän ulkopuolelle sulkemista sekä sosiaalista hyväksyntää. Tässä väitöskirjassa tutkittiin, miten sosiaalinen hyljeksintä ja sosiaaliseen vuorovaikutukseen osallistuminen (inkluusio) vaikuttavat toisen ihmisen katseeseen reagoimiseen (tutkimukset I-III). Tämän lisäksi kirjallisuuskatsauksessa tarkasteltiin laajemmin, miten sosiaalinen hyljeksintä muuntaa sosiaalisen tiedon käsittelyä (tutkimus IV).

Tutkimuksen I tavoite oli selvittää, tehostaako suoran katseen näkeminen hyljeksinnän jälkeistä mielialan palautumista. Kahdessa kokeessa tälle hypoteesille ei löydetty tukea. Sosiaalisesti hyljeksityksi tulleilla tutkittavilla kokemus sosiaalisten perustarpeiden täyttymisestä palautui kahden mittauskerran välillä samalla tavalla riippumatta siitä, näkivätkö tutkittavat mittausten välissä videon kohti katsovista vai alaspäin katsovista kasvoista. Tutkimus II tarkasteli, miten hyljeksintä ja inkluusio verkossa tapahtuvassa sosiaalisessa vuorovaikutuksessa vaikuttavat katsesuuntien arviointeihin. Tulokset osoittivat, että inkluusioryhmään ja ei-sosiaaliseen vertailuryhmään verrattuna hyljeksityksi tulleet tutkittavat arvioivat kapeammalle alueelle kohdistettujen katsesuuntien olevan suunnattu heihin. Tämän muutoksen toisten ihmisten katsesuuntien arvioinneissa tulkittiin liittyvän välttämismotivaatioon. Inkluusio- ja vertailuryhmien välillä ei ollut eroa katsesuuntien arvioinneissa. Tutkimus III testasi, hidastaako hyljeksintä tai inkluusio tarkkaavuuden irrottamista kohti katsovista kasvoista. Hypoteesien vastaisesti vain inkluusioryhmässä tarkkaavuuden irrottaminen oli hitaampaa kohti katsovista kasvoista alaspäin katsoviin kasvoihin verrattuna. Hyljeksintäryhmän ja ei-sosiaalisen vertailuryhmän välillä ei ollut eroa; molemmissa ryhmissä tarkkaavuuden siirtäminen pois kasvoista oli yhtä nopeaa riippumatta siitä, katsoivatko kasvot kohti vai alaspäin.

Tutkimuksen IV kirjallisuuskatsaus osoitti, että hyljeksinnän on havaittu muuntavan sosiaalisen tiedon käsittelyä monin tavoin. Hyljeksintä muuntaa sosiaalisesta tiedosta tehtyjä tulkintoja ja vaikuttaa siihen, miten tarkkaavuutta suunnataan erilaisiin sosiaalisiin ärsykkeisiin. Nämä vaikutukset voivat olla erilaisia riippuen tilannetekijöistä ja hyljeksityksi tulleen henkilön yksilöllisistä piirteistä. Hyljeksintä myös parantaa sosiaalisesti merkityksellisen tiedon muistamista ja jopa parantaa sosiaalisen tiedon varhaista käsittelyä, kuten lisää tarkkuutta kasvonilmeiden

tunnistamisessa. Tutkimuskirjallisuudessa havaittiin kuitenkin useita merkittäviä aukkoja, kuten että alan tutkimuksessa ei oltu juurikaan tarkasteltu mekanismeja, jotka välittävät hyljeksinnän vaikutuksia sosiaalisen tiedon käsittelyyn. Näiden aukkojen paikkaamiseksi ehdotettiin jatkotutkimuksia.

CONTENTS

ORIGINAL PUBLICATIONS

This dissertation consists of the following four publications, which will be referred to in the text by their Roman numerals I – IV.

Publication I	Syrjämäki, A. H., Lyyra, P., Peltola, M. J., & Hietanen, J. K. (2017). When a look is not enough: No evidence for direct gaze facilitating recovery after social exclusion. Social Cognition, 35, 601-618. doi:10.1521/soco.2017.35.6.601
Publication II	Syrjämäki, A. H., Lyyra, P., & Hietanen, J. K. (2018). I don't need your attention: ostracism can narrow the cone of gaze. Psychological Research. doi:10.1007/s00426-018-0993-8
Publication III	Syrjämäki, A. H. & Hietanen, J. K. (2018). Social inclusion, but not exclusion, delays attentional disengagement from direct gaze. Psychological Research. doi:10.1007/s00426-018-1108-2
Publication IV	Syrjämäki, A. H. & Hietanen, J. K. (2018). The effects of social exclusion on processing of social information - A cognitive psychology perspective. British Journal of Social Psychology, 58, 730-748. doi:10.1111/BJSO.12299

1 INTRODUCTION

Humans are fundamentally social beings. Most of us spend a great deal of time interacting with others, as well as thinking about our relationships. We are driven to maintain interpersonal bonds, because belonging is one of the most basic human needs, only surpassed by physiological needs, and a need for safety (Baumeister & Leary, 1995; Maslow, 1943). Social exclusion is a common experience, which threatens the need for belonging (Williams, 2007). The term social exclusion encompasses various types of interpersonal behaviors, in which an individual is rejected, ostracized, or otherwise left out of social interactions and relationships (for definitions of different types of social exclusion, see e.g., Blackhart, Nelson, Knowles, & Baumeister, 2009; Williams, 2007). Even a brief experience of exclusion is aversive (Gerber & Wheeler, 2009), and prolonged exclusion can have adverse consequences, such as depression, anxiety (Leary, 1990), and in some cases, even violent behavior (Leary, Kowalski, Smith, & Phillips, 2003).

Eye gaze is one of the most important nonverbal cues to communicate social exclusion and social inclusion. Direct gaze (gaze pointed at another individual's eye area) signals that the looker is attending to the other person (Conty, George, & Hietanen, 2016), and it is often a starting point for social interaction. Direct gaze communicates motivation to approach the other individual (Adams & Kleck, 2005), and in the perceiver, it activates approach-related neural mechanisms (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008). Conversely, gaze aversion signals motivation to avoid interaction (Adams & Kleck, 2005), and it is one of the most frequently used cues to convey social exclusion (Williams, Shore, & Grahe, 1998). In the observer, gaze aversion evokes feelings of exclusion and low relational evaluation (Wirth, Sacco, Hugenberg, & Williams, 2010).

The aim of this dissertation is to investigate how socially excluded and socially included individuals respond to others' eye gaze, and more generally, how social exclusion influences social information processing. The dissertation includes four original publications. The first three contain empirical studies, in which we investigated 1) whether perceiving direct gaze ameliorates affective distress evoked by social exclusion, 2) how social exclusion and social inclusion in an online interaction alters judgments of others' gaze directions, and 3) whether social exclusion or social inclusion slows down attentional disengagement from faces portraying direct gaze. The empirical studies inspired us to take a wider look into how social exclusion influences processing of social information, and thus, the research on this topic was reviewed and evaluated in the fourth publication.

Before presenting the current studies in detail, I will provide a short overview of previous research relevant for the present work. First, I will look into how eye gaze is used in social interaction and how another person's gaze influences the perceiver's attention and affect. After this, I will review previous research on how social exclusion influences excluded individual's affect, motivation, and behavior, and how exclusion modulates processing of social information.

1.1 Eye gaze in social interaction

The primary function of the eyes is to receive visual information, but human beings also use eyes to communicate. Eyes are used, for instance, to regulate interactions, provide information, and to express intimacy (Kleinke, 1986). Averted gaze can signal that there is something important in the gazed-at location, but it can also indicate disinterest in the ongoing social interaction. Direct gaze, in turn, conveys interest in the other person and willingness to engage in an interaction. Because of its high social relevance, direct gaze evokes various responses in the perceiver, such as enhanced attention towards the looker's face, and increased self-referential processing (for reviews, see Conty et al., 2016; Senju & Johnson, 2009).

Humans allocate a large amount of attentional resources to others' faces, and especially to faces portraying direct gaze. People tend to look longer at faces portraying direct gaze as compared to faces looking away (Mojzisch et al., 2006; Wieser, Pauli, Alpers, & Mühlberger, 2009). Interestingly, people do not only voluntarily engage attention with faces portraying direct gaze, but direct gaze seems to efficiently capture the observer's attention. Faces showing direct gaze are located more rapidly from a crowd of faces than faces with other gaze directions (Böckler, van der Wel, & Welsh, 2014; von Grünau & Anston, 1995; for criticism, see Cooper, Law, & Langton, 2013), and perceiving direct gaze, relative to averted gaze, evokes stronger physiological attention orienting responses (Akechi et al., 2013). Receiving direct gaze takes up cognitive resources, so that performance in concurrent cognitive tasks may be impaired (Conty, Gimmig, Belletier, George, & Huguet, 2010). Importantly, it has also been proposed that when an individual shifts attention from a face to another stimulus, direct gaze may slow down the attentional disengagement (Senju & Hasegawa, 2005; Ueda, Takahashi, & Watanabe, 2014).

The eye area is vital in communicating affective information. The muscles around the eyes are used to form various facial expressions (Ekman & Rosenberg, 1997), and the looker's gaze direction also conveys affectively salient information to other people. Adams and Kleck (2005) showed that recognition of facial expressions of approach-related emotions (joy and anger), was enhanced when the face was portraying direct gaze, relative to averted gaze, whereas averted gaze facilitated recognition of avoidance-related emotional expressions (fear and sadness). In addition to signaling the looker's emotions, gaze direction also influences the perceiver's affective state. Direct gaze can sometimes be aversive, especially if the looker simultaneously signals threat with an angry facial expression (Lamer, Reeves, & Weisbuch, 2015), or if the perceiver suffers from social anxiety (Myllyneva, Ranta, & Hietanen, 2015; Wieser et al., 2009). However, in socially neutral contexts, direct gaze is generally experienced as a positive cue. Viewing direct gaze, compared to averted gaze, causes more activation in the facial muscles related to positive facial emotions (Hietanen et al., 2018), and attenuates the startle reflex evoked by aversive noise (Chen, Peltola, Dunn, Pajunen, & Hietanen, 2017). Receiving direct gaze also increases subjective feelings of connectedness (Wesselmann, Cardoso, Slater, & Williams, 2012), and speeds up recognition of positively valenced affective words (Chen, Helminen, & Hietanen, 2017; Chen, Peltola, Ranta, & Hietanen, 2016). Together with findings showing that faces with direct gaze are evaluated more positively than faces looking away (Ewing, Rhodes, & Pellicano, 2010; Mason, Tatkow, & Macrae, 2005), these studies strongly suggest that direct gaze is generally experienced as a positive, affiliative social cue (for a review, see Hietanen, 2018).

There is no clear-cut boundary for what constitutes as direct gaze, but people view a range of gaze directions as direct. This range, called the cone of gaze (Gamer & Hecht, 2007), can be modulated by the perceiver's individual characteristics as well as by various situational factors. A number of studies have shown that the gaze cone is particularly wide among socially anxious individuals, suggesting that these individuals are biased to view others as looking at them (Harbort, Witthöft, Spiegel, Nick, & Hecht, 2013; Schulze, Lobmaier, Arnold, & Renneberg, 2013). The looker's facial expression also influences gaze direction judgments, as the gaze cone is wider when the observed face is portraying an angry or a happy expression, compared to fearful and neutral expressions (Ewbank, Jennings, & Calder, 2009; Lobmaier & Perrett, 2011; Lobmaier, Tiddeman, & Perrett, 2008). Interestingly, also the perceiver's internal states, which vary from one situation to another, can influence the width of the gaze cone. Rimmele and Lobmaier (2012) showed that cold-induced stress, compared to a control manipulation, widened the gaze cone, which the authors interpreted as enhanced alertness to social stimuli under stressful situations. Most importantly for the present research, Lyyra, Wirth, and Hietanen (2017) recently reported that also social exclusion modulates judgments of others' gaze directions. They found that the width of the gaze cone was wider among participants who had been socially excluded in a virtual ball-tossing game as compared to socially included participants. It was suggested that exclusion widened the gaze cone, reflecting coping with this adverse experience by seeking affiliative cues.

1.2 Affective and behavioral responses to social exclusion

When people are socially excluded, they show various negative outcomes, such as lowered mood (Gerber & Wheeler, 2009) and increased aggression (Leary, Twenge, & Quinlivan, 2006). The temporal need-threat model (Williams, 2007) is one of the most impactful theories describing the affective responses to social exclusion. According to this theory, the most crucial effect of exclusion is that it threatens the basic social needs of belonging, control, meaningful existence, and self-esteem. The responses to exclusion can be divided into three separate stages. The initial, reflexive reaction is a rapid warning signal, which alerts the individual of the threat of exclusion. In the following reflective stage, the individual attempts to fortify the threatened basic needs. If exclusion is prolonged and the individual is unsuccessful in restoring basic needs, he or she may end in the final, resignation stage. To date, empirical research on the resignation stage has been scarce, but it has been proposed that individuals who enter this stage become withdrawn, alienated, and helpless, as they give up on trying to restore basic needs (Riva, Montali, Wirth, Curioni, & Williams, 2017; Williams, 2007).

During and immediately following social exclusion (i.e., at the reflexive stage), individuals do not only report lowered mood (Blackhart et al., 2009; Williams, Cheung, & Choi, 2000) and lowered satisfaction of basic needs (Hartgerink, van Beest, Wicherts, & Williams, 2015), but they also report experiencing pain (Chen, Williams, Fitness, & Newton, 2008). Some researchers have argued that the social pain evoked by exclusion is more than a figure of speech, and that physical and social pain operate via shared neural mechanisms (Eisenberger & Lieberman, 2004; Eisenberger, Lieberman, & Williams, 2003; MacDonald & Leary, 2005). While this view is controversial (for criticism, see Somerville, Heatherton, & Kelley, 2006; Woo et al., 2014), the function of physical and social pain is thought to be similar: they warn the individual of physical and social harm, respectively (MacDonald & Leary, 2005). They are also similar in that these responses are automatic and difficult to suppress. A physical injury may unavoidably cause physical pain, and similarly social exclusion necessarily leads to affective distress, even when being excluded is inconsequential or even beneficial for the individual (Van Beest & Williams, 2006; Zadro, Williams, & Richardson, 2004).

The rapid early response to exclusion is followed by the reflective stage, during which the excluded individual attempts to fortify threatened basic needs (Williams, 2007). In laboratory studies, participants' affect recovers within minutes after exclusion (Wesselmann, Ren, Swim, & Williams, 2013; Wirth & Williams, 2009), although socially anxious individuals may show lowered mood as long as 45 minutes after an exclusion manipulation, suggesting that these individuals are particularly strongly influenced by exclusion (Zadro, Boland, & Richardson, 2006). Being socially included helps individuals recover from exclusion. Excluded individuals' affect improves more after an inclusive social interaction compared to the passing of time (Zwolinski, 2014), and after an online chat compared to a solitary video game (Gross, 2009). Interestingly, even receiving negative feedback from others may be sufficient to cause recovery from exclusion (Rudert, Hales, Greifeneder, & Williams, 2017). This may suggest that even unfriendly acknowledgment may sometimes be better than being completely ignored (see also O'Reilly, Robinson, Berdahl, & Banki, 2014).

Importantly, exclusion evokes various motivational and behavioral responses, which are thought to reflect coping in the reflective stage. Researchers have identified three different motivational and behavioral tendencies as a response to exclusion (Smart Richman & Leary, 2009). First, excluded individuals may act in affiliative ways: for instance, they may show interest in joining group activities (Maner, DeWall, Baumeister, & Schaller, 2007), and they may mimic others' nonverbal behavior (Lakin, Chartrand, & Arkin, 2008), which may be attempts to restore one's sense of belonging. Secondly, people may respond to exclusion by acting in aggressive ways (Twenge, Baumeister, Tice, & Stucke, 2001; Warburton, Williams, & Cairns, 2006), which has been suggested to be a way to regain sense of control (Gerber & Wheeler, 2009). Finally, individuals sometimes respond by seeking solitude and by withdrawing from social interactions, which could be an attempt to protect oneself from further hurt (Ren, Wesselmann, & Williams, 2016).

One important aim in the current social exclusion research is to understand why exclusion evokes these different, even seemingly conflicting behavioral and motivational responses. Smart Richman and Leary (2009) proposed a multimotive model, according to which the behavioral response to exclusion is determined by various contextual factors and the individual's inferences of the exclusion episode. Behavior is influenced by, for instance, whether the excluded individual has access to alternate relationships, whether the individual is able to reaffiliate with the excluder, and whether the person sees the exclusion as unfair or fair. The relationship between exclusion and behavior is presumably quite complex, as several different factors likely moderate the effects of exclusion on motivation and behavior. The current empirical research has identified only some of these factors (Maner et al., 2007; Sunami, Nadzan, & Jaremka, 2018; Warburton et al., 2006), and researchers are still actively discussing which factors determine whether an excluded individual will act in affiliative, aggressive, or socially avoidant ways (DeWall & Richman, 2011; Shilling & Brown, 2016; Wesselmann, Ren, & Williams, 2015).

1.3 Social exclusion and processing of social information

Several studies have suggested that exclusion alters processing of social information, and causes individuals to become highly attentive to social information. Gardner, Pickett, and Brewer (2000) showed that exclusion (vs. control manipulations) improved recall of diary entries containing social information, but impaired recall of non-social entries. Partly based on this finding, they proposed that humans possess a social monitoring system, whose purpose is to help an individual regulate the need for belonging (see also Pickett & Gardner, 2005; Pickett, Gardner, & Knowles, 2004). It was argued that activation of the social monitoring system enhances social information processing, which increases chances of success in social interactions, allowing one to satisfy the thwarted need for belonging.

Subsequent studies have provided further evidence that socially excluded individuals perform particularly well in various social information processing tasks. In one of the earliest studies on the issue, Pickett et al. (2004) reported that high self-reported need for belonging was correlated with better acuity in identification of facial expressions and affective valence of vocal tones. Another study showed that participants reflecting on exclusion, compared to control groups, were more accurate in identifying whether faces were portraying genuine or fake smiles (Bernstein, Young, Brown, Sacco, & Claypool, 2008). In addition, one research group found that exclusion improved accuracy at differentiating between faces belonging to two different categories (e.g., a happy and an angry face), but impaired acuity at distinguishing between faces belonging to the same category (e.g., two faces differing in the intensity of an angry expression; Sacco, Wirth, Hugenberg, Chen, & Williams, 2011). They argued that exclusion enhances between-category discrimination accuracy, which is highly important for achieving reinclusion, at the expense of within-category discrimination accuracy, which is less critical for excluded individuals.

Several studies have also found that exclusion influences the way participants attend to affective social stimuli. DeWall, Maner, and Rouby (2009) conducted several experiments, in which exclusion increased attention allocation towards smiling faces. Exclusion, compared to control manipulations, enhanced visual search performance for smiling faces, but not for faces showing other expressions (Experiment 1), increased fixations to smiling faces in an array of different affective faces (Experiments 2-3), and increased a tendency to shift attention towards smiling faces instead of faces showing a neutral expression (Experiment 4). Some later studies have found convergent evidence that exclusion increases allocation of attention to smiling faces (Buckner, DeWall, Schmidt, & Maner, 2010; Tanaka & Ikegami, 2015; Xu et al., 2015), although some studies have also found increased attention to angry faces (Tuscherer et al., 2015) and sad faces as well (Kraines, Kelberer, & Wells, 2018).

While much of the research in this field has investigated how excluded individuals process and attend to different facial expressions, there is some evidence suggesting that exclusion also modulates responses to others' eye gaze. One study found that the gaze-cuing effect (the inclination to shift attention towards the direction of another person's gaze) was amplified among socially excluded participants and participants with low self-esteem, compared to included participants and participants with high self-esteem, respectively (Wilkowski, Robinson, & Friesen, 2009; but for a recent finding that exclusion decreased the gaze-cuing effect, see Capellini, Riva, Ricciardelli, & Sacchi, 2019). Excluded individuals might increase attention to others' eyes, as they seek reinclusion opportunities, and direct gaze might be an especially important inclusive cue. Consistent with this, it has been reported that excluded participants looked more in the eyes of their interaction partners than included participants did, possibly because they tried to get into eye contact (Böckler, Hömke, & Sebanz, 2014). Furthermore, as mentioned earlier, Lyyra et al. (2017) found that the gaze cone (the range of gaze directions judged as direct) was wider among excluded participants, compared to included participants. These findings suggest that, as a part of their coping strategies, excluded individuals respond to others' eye gaze in an altered way. However, there has been relatively little research on this issue to date, and thus we do not currently have a detailed understanding on how and why exclusion influences responses to others' gaze.

2 AIMS OF THE STUDY

2.1 Direct gaze and recovery from exclusion

As described in the introduction, the affective responses to exclusion can be divided into an initial reflexive stage and a latter reflective stage, during which an individual attempts to fortify basic needs (Williams, 2007). Excluded individuals have such a powerful need to be acknowledged that not only pleasant social interactions (Gross, 2009; Zwolinski, 2014), but even negative feedback from others (Rudert et al., 2017) alleviates the affective distress evoked by exclusion. Excluded individuals attend to affiliative cues, such as smiling faces (DeWall, Maner, & Rouby, 2009), and are biased to view others as portraying direct gaze (Lyyra et al., 2017), possibly because receiving cues of acceptance and acknowledgment can ameliorate the adverse effects of exclusion. As direct gaze signals that one is attended to by the looker (Conty et al., 2016) and increases feelings of connectedness (Wesselmann et al., 2012), we hypothesized that viewing direct gaze would facilitate recovery of affect after social exclusion.

Study I contained two experiments, in which we investigated whether receiving direct gaze would help individuals recover from social exclusion. At the beginning of the experiments, participants were excluded or included in Cyberball (Williams & Jarvis, 2006). In this widely used social exclusion manipulation, participants play a virtual ball-tossing game, supposedly with other participants, but in actuality with preprogrammed characters, who either exclude or include the participants in the game. After the manipulation, participants were shown a video of a person portraying either direct gaze or looking downwards. Satisfaction of basic social needs were measured using a standard questionnaire (Molet, Macquet, Lefebvre, & Williams, 2013; Wirth & Williams, 2009) both right after the social exclusion manipulation (reflexive stage) and after viewing the eye gaze video (reflective stage). Our first hypothesis was that, in the reflexive stage, excluded participants would report lower satisfaction of basic needs than included participants. Second, we hypothesized that excluded participants would report higher basic need satisfaction in the reflective stage than in the reflexive stage, indicating recovery between the two measurements. Most importantly, we hypothesized that excluded participants who viewed the direct gaze videos would report higher satisfaction of basic needs in the reflective stage, compared to the excluded participants who viewed videos with downward gaze. This would suggest that receiving direct gaze facilitates recovery of basic needs among excluded participants.

2.2 Exclusion and gaze direction judgments

An earlier finding that socially excluded participants had a wider gaze cone as compared to included participants (i.e., accepted a wider range of gaze directions as direct), was interpreted to reflect excluded participants' attempts at seeking reinclusion (Lyyra et al., 2017). However, as discussed earlier, excluded individuals do not always attempt to cope with exclusion by seeking reinclusion, but they may also withdraw from social interactions or act aggressively. According to the multimotive model (Smart Richman & Leary, 2009), a prosocial, affiliative response is likely when the excluded individual has an opportunity for reaffiliation. However, when there is no possibility for reaffiliation, the individual is likely to withdraw from social interactions (for similar suggestions, see also Cuadrado, Tabernero, & Steinel, 2015; DeWall & Richman, 2011; Romero-Canyas et al., 2010). If widening of the gaze cone indeed reflects an affiliative response to exclusion (Lyyra et al., 2017), then this effect might not occur in a context where affiliation is not possible. In such context, exclusion might possibly cause narrowing, rather than widening of the gaze cone.

In Study II, we investigated the possibility that exclusion might lead to narrowing of the gaze cone when there is no opportunity for reaffiliation. Like in the Lyyra et al. (2017) study, participants were socially excluded or included in Cyberball (or as a novel contribution, completed a non-social control task, which will be described later) and, after the manipulation, judged whether faces showing varying degrees of gaze aversion were looking at them or not. However, unlike in the previous study, participants were led to believe the Cyberball game was played online with other participants located in other laboratories, rather than through a local area network with other participants located in the same room. Thus, excluded participants would have no opportunity for reaffiliation, and the social interaction was limited to the ball-tossing game. We hypothesized that excluded participants would have a narrower gaze cone than included participants, and participants in the control group. Alternatively, if situational factors do not modulate the effects of exclusion on gaze direction judgments, exclusion should lead to widening of the gaze cone, compared to the other groups, as in the previous study (Lyyra et al., 2017).

2.3 Exclusion and disengagement of attention from direct gaze

It has been proposed that direct gaze holds a perceiver's attention; when attention has to be disengaged from a face, the disengagement is delayed if the face is portraying direct gaze (Senju & Hasegawa, 2005). As exclusion leads to increased allocation of attention to faces showing affiliative facial expressions (DeWall, Maner, & Rouby, 2009) and enhances attentional shifts triggered by averted gaze (Wilkowski et al., 2009), exclusion might also amplify the attention holding effect of direct gaze.

Investigating whether exclusion would enhance attention holding by direct gaze was the main aim of Study III. Participants' feelings of social exclusion and social inclusion were again manipulated using Cyberball, or they underwent a non-social control manipulation. After the manipulation, participants completed an attentional disengagement task, similar to the one used in the study by Senju and Hasegawa (2005). Participants were presented with a face showing direct or downward gaze in the fixation, and after a short delay, a small line appeared to either the left or right side of the face. Participants' task was to identify the line orientation, and to press a corresponding keyboard button as quickly as possible. Response times in identifying the line orientation were measured. We hypothesized that the response times would be longer on direct gaze trials than downward gaze trials, which would indicate delayed attentional disengagement from direct gaze. Most importantly, we expected the difference in response times between the two types of trials to be larger in the social exclusion group, than in the control group, indicating that exclusion slows down disengagement of attention from direct gaze.

2.4 Disentangling effects of social exclusion and social inclusion

While the Cyberball manipulation has been used in hundreds of studies (Hartgerink et al., 2015), an important limitation of most of these experiments is that they have not been able to disentangle effects of social exclusion from the effects of social inclusion. Typically, researchers have used social inclusion as the only control group and have interpreted differences between exclusion and inclusion groups to reflect effects of social exclusion (for exceptions using other types of controls, see Brown, Young, Sacco, Bernstein, & Claypool, 2009; Dvir, Kelly, & Williams, 2018; Riva, Williams, Torstrick, & Montali, 2014). However, there are compelling reasons to believe that social inclusion can also influence participants in various ways. Engaging in social interactions and perceiving affiliative cues evoke positive affective responses (Chen et al., 2016; McIntyre, Watson, Clark, & Cross, 1991). Furthermore, meta-analytic evidence shows that social exclusion studies using neutral control groups report smaller effects on mood than studies comparing excluded participants to socially accepted participants (Blackhart et al., 2009). One study found that reflecting on social inclusion, as compared to exclusion and control groups, decreased interest in joining low-prestige social groups (Sacco & Bernstein, 2015). Brown and colleagues (2009) provided direct evidence that social inclusion in Cyberball can evoke responses in participants. They found that inclusion, but not exclusion, as compared to a no manipulation condition, increased interest in mating behavior. These findings are important, because they show that not only exclusion, but also inclusion can evoke effects that should be investigated. They also suggest that inclusion is not always an appropriate control condition when examining effects of exclusion, and thus findings from studies lacking additional control conditions cannot be taken as firm evidence that exclusion was driving the observed effects.

In Studies II and III, we employed a non-social control manipulation, to which we compared the exclusion and inclusion groups. Participants assigned to this condition played a ball-tossing game, which was similar to that in the other conditions, but contained no social interaction. Rather than tossing a ball with other characters, participants were throwing a ball into baskets. This control manipulation had advantages over other non-social control tasks used in previous Cyberball studies. In these studies, participants in non-social control groups were asked to imagine natural scenery (Dvir et al., 2018; Riva et al., 2014) or were given no manipulation at all (Brown et al., 2009). Like these control conditions, the control ball-tossing game used in our studies contained no social interaction, but it more closely resembled the standard version of Cyberball, making it a more appropriate control condition.

By using the non-social control group, we could investigate whether social inclusion would influence participants' affect (as measured by a basic need, mood, and pain questionnaire in Studies II-III) as well as the width of the gaze cone (Study II), and attentional disengagement from direct gaze (Study III). Based on previous research, it seemed likely that inclusion would have little or no effect on affect (Dvir et al., 2018; Riva et al., 2014). However, there was some basis to expect social inclusion to influence responses to others' gaze. It has been reported that a positive mood induction, relative to induction of neutral or negative mood, increased eye contact in a subsequent interaction (Natale, 1977), and that priming participants with sentences related to positive or self-related social sentences, as compared to control sentences, increased the effect of direct gaze on self-reported arousal (McCrackin & Itier, 2018). It seems plausible, then, that an inclusive social interaction could also modulate the gaze cone (in Study II), or slow down disengagement of attention from direct gaze (in Study III).

2.5 Review of studies on exclusion and social information processing

The empirical studies inspired us to take a broader look on how social exclusion modulates social information processing. The research on the topic was reviewed and critically discussed in Study IV. The first goal was to describe the types of social information processing effects that exclusion research had found. A second important aim was to evaluate this research and the conclusions researchers had drawn from the studies, by looking at the field from the perspective of cognitive psychology. Research in this area has typically paid relatively little attention to the specific cognitive processes, on which exclusion exerts its effects. By taking a cognitive psychology perspective, we aimed to examine what the current body of evidence reveals about the issue. Vitally, we aimed to identify gaps that earlier research had left and to provide directions for future studies on the topic.

3 METHODS AND RESULTS

3.1 General methodology of the empirical studies

Participants in all of the empirical studies (Studies I-III) were adults, predominantly Finnish students. All participants reported no psychiatric or neurological disorders. They signed a form of informed consent, and received partial course credit or a movie ticket for participation. At the end of each experiment, participants were thoroughly debriefed. Ethical statements for the studies were obtained from the Ethics Committee of the Tampere region.

Participants arrived in the laboratory in groups of three (Study I, Exp. 2, Study III) or four (Study I, Exp. 1), or alone (Study II). In all of the experiments, feelings of social exclusion and social inclusion were manipulated with Cyberball 4.0 (Williams & Jarvis, 2006; see Figure 1A). In this manipulation, participants played a ball-tossing game on a computer, in which three (Study I, Exp. 2, Studies II-III) or four (Study I, Exp. 1) characters were throwing a ball with each other. One of the characters was controlled by the participant, and the participants were led to believe the other characters were controlled by the other participants present in the laboratory (Studies I and III), or by participants located in other laboratories, playing the game online (Study II). In reality, the other characters were controlled by the computer, and their actions were preprogrammed. Participants were either included in the game, receiving the ball as often as the other characters (inclusion condition), or excluded from the game, so that they received the ball only once from each character in the beginning of the game (exclusion condition). The game lasted for 30 (Studies I, Exp. 2, Studies II-III) or 45 throws (Study I, Exp. 1) in total. The number of throws differed between the experiments so that participants in the inclusion group made the same number of throws regardless of whether the experiment used the three- or four-player version of the game. The reason for changing to the three-player version after the first experiment was that scheduling the experiment session was easier for three participants than for four participants at a time and because the three-player version is more commonly used (Hartgerink et al., 2015).

Studies II and III also contained a non-social control group, to which we compared the excluded and included participants, so that the effects of social exclusion could be disentangled from the effects of social inclusion (see Figure 1B). Participants assigned to the control group played a similar ball-tossing game, but instead of throwing a ball with other characters, they were throwing a ball into baskets. After each throw, the ball returned to the participant's character. Participants in the non-social control group made 10 throws in the game, i.e., the same number as in the inclusion condition. The pace of the game in all conditions was adjusted so that the duration of the game was similar across conditions.

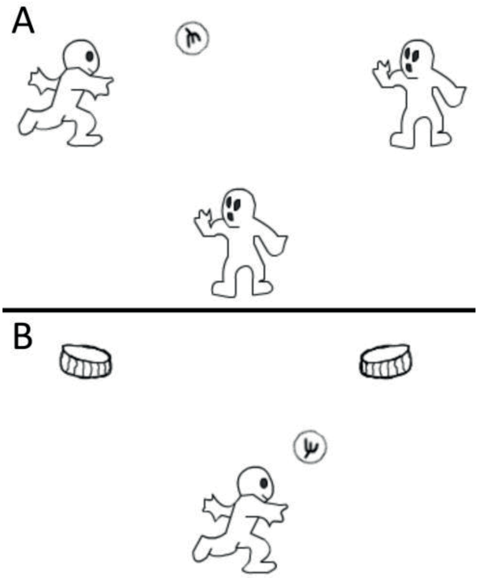

Figure 1. Illustrations of the social inclusion and exclusion conditions (A) and the non-social control condition (B) in Cyberball.

Participants were randomly assigned in one of these conditions. In Studies II and III, participants who had to be excluded from the analyses (see below for details) were replaced to ensure a sufficient number of participants in all conditions.

Immediately following the manipulation, participants filled in a questionnaire measuring basic need satisfaction, positive and negative mood, and social pain during the game. The questionnaire has been used in several earlier studies on social exclusion (e.g., Molet et al., 2013; Wirth & Williams, 2009). It contains five items measuring each of the four basic social needs proposed by Williams (2007; belonging, self-esteem, meaningful existence, control), and four items measuring positive mood and negative mood. Participants responded on a 1-5 scale (Studies I and III), or on a visual analog scale, scored 0-100 (Study II), based on what they felt during the game. In Studies II and III, the questionnaire was abbreviated, so that only one item for each basic need and both positive and negative mood was included. This was done so that the interval between the manipulation and the main measurement of the study was as short as possible. In all of the studies, the basic need items were reverse scored when necessary, and averaged to create a basic need satisfaction index. We also asked participants to assess the amount of pain they experienced during the game on a 0-100 visual analog scale.

In each study, we led participants to believe the study was investigating "mental visualization", which is a typical cover story used in studies utilizing the Cyberball manipulation. Participants were instructed to mentally visualize the Cyberball game. To enhance the cover story, in the beginning of each experiment, participants filled in a questionnaire ostensibly measuring their tendency to mentally visualize.

Participants' awareness of the deception in Cyberball was probed at the end of each experiment. In Study I, Exp. 1, and Study II, suspicion was inquired with an informal, unstructured interview. In Study I, Exp. 2, and Study III, suspicion was measured with a funnel-type questionnaire with six open-ended questions. Full details are available in the original publication of Study III.

All materials in the studies were presented on 19" LCD monitors with 1280 × 1024 resolution and 60 Hz refresh rate. In Studies II and III, participants' head position was fixed at 63 cm and 57 cm from the screen, respectively. E-Prime® 2.0 software was used for stimulus presentation and for acquiring data. Firefox Internet browser was used to present the Cyberball game.

For the sake of legibility, only the main findings of the statistical analyses will be presented here. All details of the statistical analyses can be found in the original publications.

3.2 Study I

3.2.1 Methods of Study I

Study I contained two experiments with a similar design, both investigating whether direct gaze alleviates distress caused by exclusion. For Exp. 1, 80 participants volunteered (21 males, Mage = 25.6 years, SDage = 6.0). We excluded four participants from the analyses, three for expressing suspicion about the Cyberball manipulation (all in the exclusion group), and one for withdrawing the consent.

Thus, the final sample in Exp. 1 contained 76 participants (nexcluded, direct = 18, nexcluded, downward = 18, nincluded, direct = 20, nincluded, downward = 20). A total of 82 participants volunteered for Exp. 2 (20 males, Mage = 24.8 years, SDage = 6.3). One participant was excluded from the analyses for being familiar with Cyberball, and thus the final sample in Exp. 2 consisted of 81 participants (nexcluded, direct = 21, nexcluded, downward = 22, nincluded, direct = 20, nincluded, downward = 18). In this experiment, no participants were excluded due to suspicion because the level of suspicion was not correlated with the dependent variables. It should be noted however, that participants in the exclusion group indicated significantly more suspicion in the post-experiment questionnaire than participants in the inclusion group.

Immediately following social exclusion or inclusion in Cyberball (reflexive stage), participants filled in a basic need, mood, and pain questionnaire. The questionnaire was followed by the eye gaze manipulation (see below for details) and, afterwards, a reflective stage basic need, mood, and pain questionnaire. The questionnaire was the same as the one used in the reflexive stage, except participants were asked to answer based on what they felt at the moment, instead of during the game. For the sake of brevity, only the basic need data are presented below, as all measurements produced largely similar results. For the rest of the data, see the supplement of the original publication.

In the gaze direction manipulation, participants viewed a video of a person portraying either direct gaze, or downward gaze. In Exp. 1, the video showed a person portraying direct or downward gaze for one minute. The model person stayed still, except for minor movements and eye blinks. Eight different individuals (four females, four males) acted as models in the videos. To maintain the cover story, participants were instructed to mentally visualize an interaction with the individual in the video. In Exp. 2, the videos were 25-28 seconds in length, and the manipulation was designed to be less distracting than the one-minute video of a still face in Exp. 1. In the videos of Exp. 2, a model person (one female, one male) gave instructions on how to fill in the following questionnaire, while either portraying direct gaze, or downward gaze. To familiarize participants with the model, they were shown, in the beginning of the experiment, a 23-second video depicting the model person giving task instructions while alternating between direct and downward gaze.

3.2.2 Results of Study I

For mean basic need scores in each experimental group in reflexive and reflective stages in both experiments of Study I, see Figure 2. The results showed that in both experiments, excluded participants reported significantly lower basic need satisfaction than included participants immediately after the Cyberball game (reflexive stage). Excluded participants reported significantly higher basic need satisfaction in the latter, reflective stage, compared to the reflexive stage, suggesting that their basic need satisfaction improved between the two measurements. In the inclusion group, however, basic need satisfaction declined between the two stages significantly in Exp. 1, and marginally in Exp. 2. There were no differences between excluded and included participants in basic need satisfaction in the reflective stage in Exp. 1, suggesting that the effects of the exclusion manipulation on basic need satisfaction dissipated by the second measurement. In Exp. 2, however, excluded participants still reported significantly lower basic need satisfaction than included participants in the reflective stage, suggesting that the effects of the manipulation persisted until the latter stage. Most importantly, in both experiments, the gaze direction manipulation had no effect on participants' basic need satisfaction. Excluded participants reported similar levels of basic need satisfaction in the reflective stage, regardless of whether they viewed videos with direct or downward gaze.

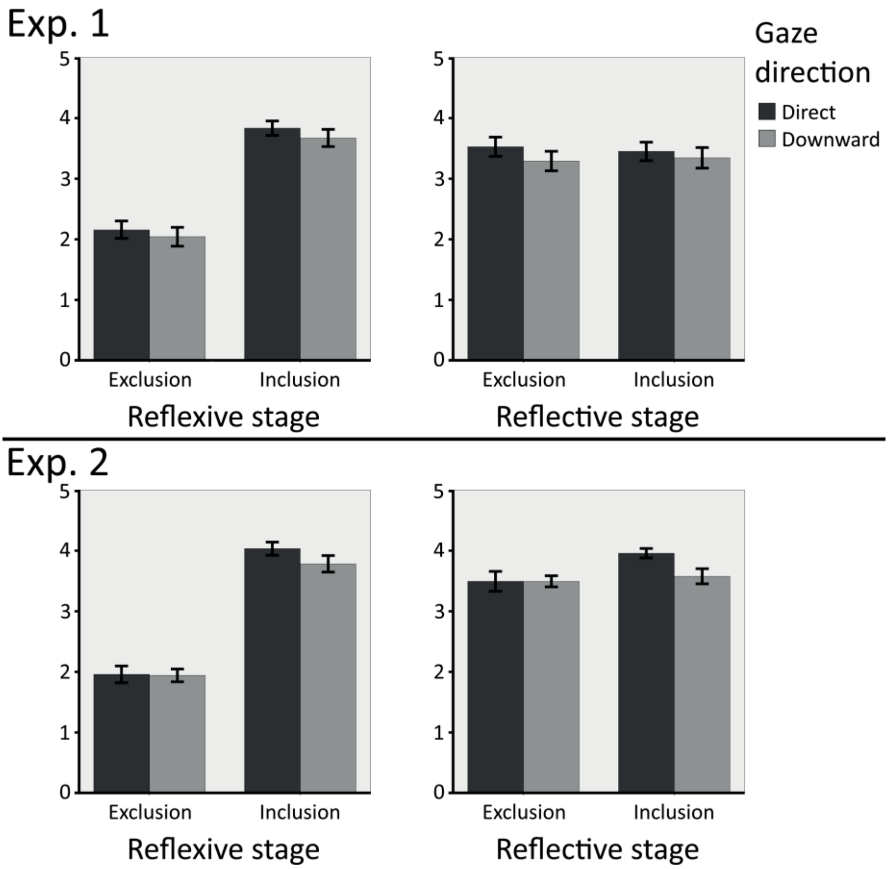

Figure 2. Mean basic need satisfaction scores in each experimental group in both the reflexive and the reflective stage in Experiments 1 and 2 of Study I. Error bars denote standard error of the mean.

As is widely recognized, null findings can be difficult to interpret. To more meaningfully interpret our results, we wanted to compare the effects of the gaze manipulation and another type of manipulation on basic need recovery. We did this by conducting two small-scale meta-analyses (Cumming, 2014). In the first one, we evaluated the effect size of the direct gaze vs. downward gaze manipulation on excluded participants' basic need recovery in the current experiments. In the second meta-analysis, we investigated how diverting attention to another task (such as focusing attention on the present, writing about an irrelevant topic, or praying), as compared to a no distraction condition, influences excluded participants' basic need recovery. Several studies had investigated this question using very similar experimental designs and dependent variables as the current experiments, making it possible to compare the results of the two meta-analyses (Hales, Wesselmann, & Williams, 2016, Experiments 1 and 3; Molet et al., 2013; Wesselmann et al., 2013). The most important finding of these analyses was that the confidence intervals for the combined effect sizes of the two types of manipulations did not overlap (see Figure 3). This shows that after exclusion, distraction facilitates basic need recovery significantly more effectively than viewing a face with direct gaze.

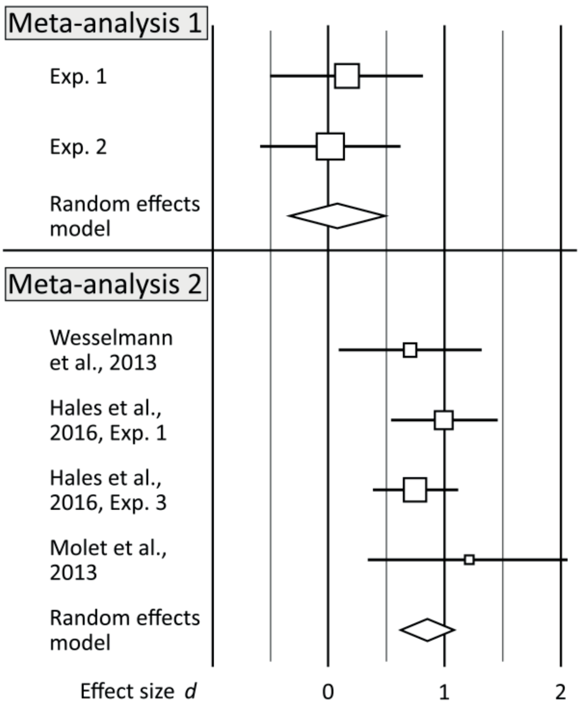

Figure 3. Effect sizes of seeing direct gaze (Meta-analysis 1), and diverting attention to another task (Meta-analysis 2) on recovery of basic needs after social exclusion in Cyberball. The horizontal lines represent the 95% CIs of the effect sizes of each study. The diamonds represent the combined effect sizes of the studies in each meta-analysis. The square sizes represent the weight of the study in the respective meta-analysis.

3.3 Study II

3.3.1 Methods of Study II

In Study II, we investigated whether exclusion would narrow or widen the gaze cone when there is no opportunity for reaffiliation. We also examined whether social inclusion, as well as exclusion, influences the width of the gaze cone and affect. A total of 81 volunteers participated in the experiment (19 males, Mage = 25.9 years, SDage = 7.7). We excluded 14 participants from the analyses. Nine were excluded for correctly indicating that they were deceived in the Cyberball game (one in the inclusion condition, eight in the exclusion condition). Four participants were excluded because the width of the gaze cone could not be calculated for these participants due to the number of "direct" responses exceeding 50 % for all gaze directions (see Ewbank et al., 2009). Finally, one participant was excluded as an outlier, as the calculated gaze cone width was not within three standard deviations from the sample mean. The final, analyzed sample consisted of 67 participants (nexcluded = 22, nincluded = 22, ncontrol = 23).

After a social exclusion, social inclusion, or a non-social control manipulation, participants filled in the basic need, mood, and pain questionnaire (see above for details), and then completed the main measurement of this study, the gaze cone task. On each trial of the task, a fixation cross was shown for 800 ms, followed by a face stimulus, shown for 150 ms. Pictures of faces of four different individuals (two females, two males), created with a 3D animation software DAZ Studio, were used as stimuli. The faces were portraying either direct or slightly averted gaze (2°, 4°, 6°, and 8° to the left and to the right). For examples of the stimuli, see Figure 4. After seeing the face, participants were shown two consecutive response windows. In the first response window, participants indicated whether they felt the person was looking directly at him/her or not, using the keyboard (1 = yes, 2 = no). In the second response window, participants assessed the strength of the feeling on a 3-point scale (1 = strong, 2 = intermediate, 3 = weak). The task consisted of two blocks of 36 trials each, resulting in 72 trials in total. In each block, each of the gaze directions of two randomly chosen individuals (a male and a female) were shown twice. Half of the pictures were horizontally flipped to eliminate any effect caused by face asymmetry. In the second block, the faces of the other two individuals were shown.

Figure 4. Examples of face stimuli used in Study II. The three stimuli shown here, from left to right, are portraying direct gaze, gaze averted 2° to the left, and 8° to the right, respectively. In the experiment, the stimuli were shown in full color.

To determine the width of the gaze cone, we first calculated the point of subjective equality (PSE), i.e., the point where the individual cannot distinguish between two different stimuli (Lyyra et al., 2017). This was done by calculating a binary logistic regression model individually for each participant based on the answers in the first response window. For the purposes of this analysis, the trials with gaze averted to the left and the right were collapsed, which resulted in five different gaze directions (0°, 2°, 4°, 6°, 8°). Trials with no responses within 7 s in the first response window (0.6%) were excluded from the data. From the regression model, we calculated the gaze deviation degree, which the participant was equally probable to indicate as direct and averted gaze. The width of the gaze cone was defined as the distance from zero degrees to the PSE, multiplied by two to cover both sides. We also analyzed eye contact impression strength, combining data from both response windows, but will not present the analyses here, as both analytic strategies yielded comparable results.

3.3.2 Results of Study II

See Table 1 for means and standard deviations for basic need, mood, and pain scores in each group in Study II. The results indicated that exclusion, compared to inclusion and control tasks, significantly lowered satisfaction of basic social needs and positive mood. In negative mood, we only found a significant difference between exclusion and inclusion groups, but not between any of the other groups. The manipulation had no effect on self-reported levels of pain.

Table 1. Basic need, mood and pain scores for each group in Study II

	Exclusion M (SD)	Inclusion M (SD)	Control M (SD)
Basic needs	28.6 (16.2)	63.0 (16.4)	61.1 (19.8)
Positive mood	33.6 (19.2)	71.7 (15.8)	65.1 (30.2)
Negative mood	31.5 (26.1)	6.2 (13.8)	17.9 (24.3)
Pain	9.8 (13.4)	4.6 (6.9)	7.4 (15.7)

Note. Basic need satisfaction, mood, and pain scores are on a 0-100 visual analog scale

Most importantly, the manipulation had an effect on the width of the gaze cone (see Figure 5). In the exclusion group, the gaze cone was significantly narrower than in the inclusion group, and marginally narrower than in the control group. There were no differences between the inclusion and the control group in the width of the gaze cone.

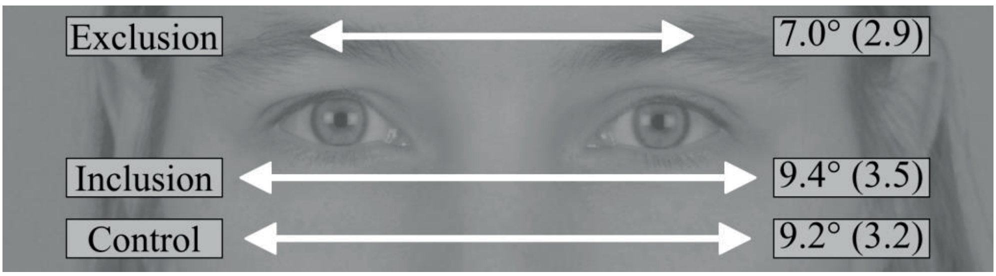

Figure 5. Means and standard deviations for gaze cone widths in all experimental groups in Study II. The mean width is projected on the observer's eye region (interpupillary distance 64 mm).

3.4 Study III

3.4.1 Methods of Study III

Study III contained an experiment, in which we examined whether social exclusion or inclusion delays disengagement of attention from faces with direct gaze. The effects of the exclusion and inclusion manipulations on affect were also investigated. For this experiment, 74 participants volunteered (26 males, Mage = 25.4 years, SDage = 6.8). All participants reported normal or corrected to normal vision. We excluded 11 participants (two in the inclusion group, nine in the exclusion group) from the sample because they indicated awareness of the deception in Cyberball in a questionnaire presented at the end of the experiment. One more participant was excluded as an outlier, as the difference in response times (RT) between direct and downward gaze trials was very large for this participant (over three standard deviations above the mean difference in the sample). Thus, the final sample consisted of 62 participants (nexclusion = 21, ninclusion = 21, ncontrol = 20).

After the Cyberball manipulation, participants filled in a short basic need and mood questionnaire (see above for details). After this, they completed an attentional disengagement task, consisting of two blocks of 128 trials each. On each trial, participants first saw a fixation cross for 650-850 ms, after which it was replaced with a picture of a face portraying either direct or downward gaze (two female and two male faces were used, created with a 3D animation software). After a 200-ms or 500-ms stimulus onset asynchrony (SOA), a target stimulus (a vertical or a horizontal line, 1.3° of visual angle) was placed 15.5° to the left or right of the face. Participants were instructed to identify the line orientation by pressing a corresponding button on a keyboard as quickly as possible while trying not to make mistakes. The response time in identifying the line orientation was the main dependent variable in this study. For an illustration of a single trial, see Figure 6.

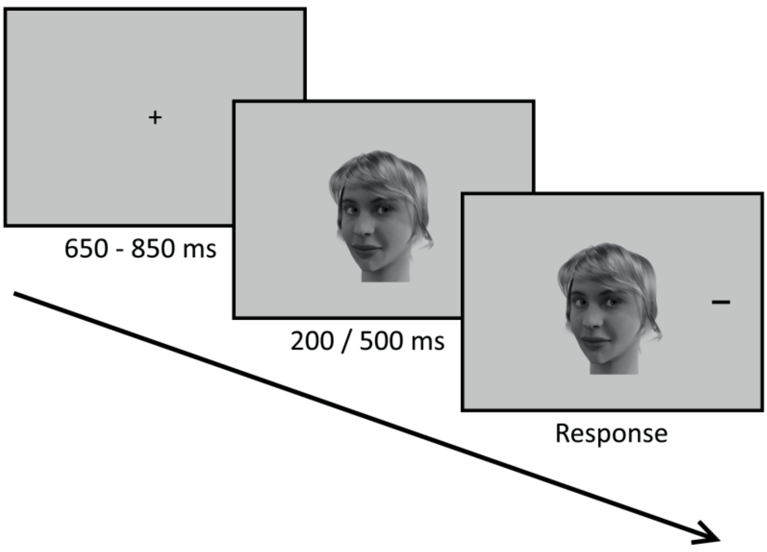

Figure 6. Illustration of a trial in the attentional disengagement task in Study III. A fixation cross was displayed for a random duration between 650-850 ms, followed by the face stimulus depicting direct or downward gaze. After a 200 / 500 ms SOA, a target stimulus appeared to the left or right of the face. Participants identified the target stimulus as quickly as possible by pressing a corresponding key on a keyboard.

Mean RTs for each combination of gaze direction, SOA, and block position were calculated individually for each participant. We removed trials with no responses (< 0.1 % of all trials), trials with incorrect responses (3.8 % of all trials), and trials with RTs outside 2.5 SD from the individual mean (2.6 % of remaining trials). To correct for non-normal distribution of the data, a square root transformation was conducted for the analyses, but untransformed scores are presented for clarity.

3.4.2 Results of Study III

For means and standard deviations for basic need, mood, and pain ratings in each group in Study III, see Table 2. These data show that exclusion evoked the expected affective responses. Excluded participants reported significantly lower basic need satisfaction and positive mood, and significantly higher negative mood and pain than the inclusion group or the control group. Included participants did not differ significantly from the control group on any of these measurements, although basic need satisfaction was marginally higher in the inclusion group.

Table 2. Basic need, mood and pain scores for each group in Study III

	Exclusion M (SD)	Inclusion M (SD)	Control M (SD)
Basic needs	2.01 (0.84)	3.85 (0.65)	3.46 (0.78)
Positive mood	2.14 (1.06)	3.67 (1.24)	3.10 (1.21)
Negative mood	2.29 (1.19)	1.10 (0.30)	1.20 (0.52)
Pain	24.4 (23.3)	1.5 (3.8)	6.0 (16.8)

Note. Basic need satisfaction and mood scores are on a 1-5 scale; pain scores are on a 0-100 visual analog scale

For mean RTs in each condition in the attentional disengagement task, see Figure 7. Surprisingly, the results showed that, in general, there were no differences in RTs between direct and downward gaze trials. Most importantly, we found an interaction between inclusionary status and gaze direction (see Figure 8). RTs were significantly longer for direct gaze trials, compared to downward gaze trials in the inclusion group, but not in the exclusion and control groups. In these groups, the RTs tended to be longer for downward gaze trials than direct gaze trials, although the difference was not statistically significant in either group. There were no differences between groups in RTs on either direct or downward gaze trials.

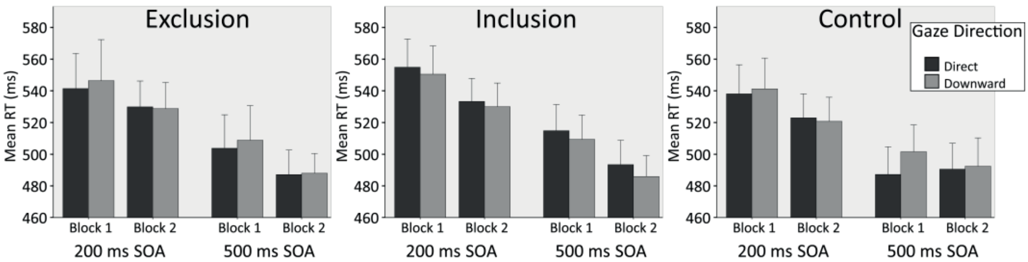

Figure 7. Mean response times in each condition in Study III. The error bars denote standard error of the mean.

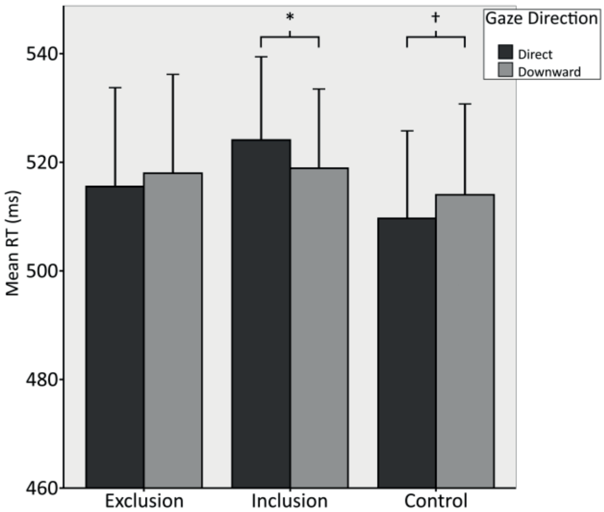

Figure 8. Mean response times on direct and downward gaze trials in the exclusion, inclusion and control groups, averaged over the two blocks and SOAs. Error bars denote standard error of the mean. $^{*}p < 0.05$, $^{\dagger}p < 0.10$

3.5 Study IV

In Study IV, we took a wider perspective on how social exclusion influences processing of social information. A review of the literature revealed that various types of effects on social information processing had been reported. First, several studies had shown that exclusion improves memory for social information, allowing excluded individuals to better remember information that is highly important for them (e.g., Bernstein, Sacco, Young, & Hugenberg, 2014; Gardner et al., 2000). Second, research had revealed that exclusion alters the way individuals view and evaluate social information: sometimes they rate social stimuli particularly positively and sometimes negatively, possibly reflecting the excluded individuals' motivational and emotional states (e.g., DeWall, Twenge, Gitter, & Baumeister, 2009; Maner et al., 2007). Third, it had been reported that exclusion modulates performance in perceptual tasks, such as enhancing facial expression recognition accuracy (e.g., Bernstein et al., 2008). Finally, exclusion had been found to influence attention, for instance, increasing the tendency to shift attention towards smiling faces and increasing engagement of attention with smiling faces (e.g., DeWall, Maner, & Rouby, 2009; Buckner et al., 2010). In other studies, increased attention towards negative faces had been reported as well (e.g., Kraines et al., 2018; Tuscherer et al., 2015).

While many intriguing social information processing effects had been demonstrated, we also identified significant gaps in the literature. Some impactful ideas were not firmly supported by the existing empirical evidence. For instance, there is a popular notion that exclusion generally increases allocation of attention to social information (e.g., Pickett et al., 2004; Shilling & Brown, 2016), but the hypothesis had not been tested in a way that allow determining whether attention was increased towards social stimuli specifically. In a similar vein, the increased attention to affective social stimuli, such as smiling faces, had often been interpreted as increased attention to affective social stimuli specifically, but because non-social control conditions had typically not been used, the findings could also reflect increased attention to affective stimuli generally, including affective non-social stimuli.

From the point of view of cognitive psychology, relatively little attention had been paid to investigating the mechanisms, which mediate the reported effects of social exclusion on processing of social information. For instance, no study had investigated whether the improved memory for social information reflects changes in memory retrieval processes specifically, or changes at earlier information processing stages, later allowing more memory to be retrieved. For effects found in other studies, researchers had discussed possible mediating mechanisms, but there was little empirical research testing the explanations. Some researchers had attributed the enhanced facial expression recognition accuracy to increased attention to the stimuli (Pickett et al., 2004), but other researchers had argued that the effect is driven by exclusion directly altering the perceptual processes, which organize visual information (Sacco et al., 2011). Similarly, different explanations had been offered regarding the mechanisms that mediate the effects of exclusion on attention. According to one influential idea, humans have a specialized social monitoring system, which directs attention to socially salient information when the need for belonging is threatened (Pickett & Gardner, 2005). Alternatively, the attentional effects could reflect excluded individuals' learned emotion regulation strategies (cf. Todd, Cunningham, Anderson, & Thompson, 2012). However, no studies had stringently tested these different explanations, and thus it is not possible to conclusively determine which explanations best account for the various effects of exclusion on social cognitive processes.

4 DISCUSSION

The present studies investigated how socially excluded and socially included individuals respond to others' eye gaze, and more broadly, how social exclusion influences processing of social information. First, we investigated whether viewing a face with direct gaze would alleviate distress caused by exclusion. In Study I, two experiments found no evidence that recovery of basic needs after exclusion was facilitated by viewing a video of a person portraying direct gaze. A second aim was to examine how exclusion influences gaze direction judgments in a context where there is no opportunity for reaffiliation with the excluders or others. The results of Study II showed that the range of gaze directions judged as direct (i.e., the gaze cone) was narrower among participants excluded in an online ball-tossing game than in an inclusion group or a non-social control group. Thirdly, we investigated whether social exclusion would delay attentional disengagement from faces with direct gaze. We found no evidence for this in Study III. The response times in identifying peripheral stimuli were similar on direct and downward gaze trials in both the social exclusion group and the non-social control group. There were also no differences in response times between the groups.

The fourth aim of this research was to investigate whether social inclusion, in addition to exclusion, would influence affect, gaze direction judgments, and attentional disengagement from direct gaze. We found no significant differences between inclusion and control groups in self-reported basic need satisfaction, positive or negative mood, or pain (in Studies II-III), or in the width of the gaze cone (in Study II). Intriguingly, however, inclusion influenced attentional disengagement in Study III. The response times in identifying peripheral stimuli were longer for direct gaze trials than downward gaze trials in the inclusion group, but not in the exclusion and control groups.

Finally, we took a broader look into how exclusion modulates social information processing, by reviewing and evaluating research on the topic from a cognitive psychology perspective in Study IV. Exclusion had been found to influence memory for social information, and to influence performance in perceptual tasks, such as improving facial expression recognition. Exclusion had also been found to modulate evaluations of social stimuli, sometimes causing individuals to judge others particularly positively, and sometimes negatively. Finally, exclusion had been found to influence attention allocation, such as increasing the tendency to shift attention towards smiling faces, but sometimes towards threatening faces as well. Importantly, there were also notable gaps in the literature. Some of the conclusions drawn from the studies were not firmly supported by the evidence, or there were several alternative explanations for the findings. The cognitive mechanisms driving the reported social information processing effects had also not been carefully investigated.

I will next discuss these findings in more detail. First, I will dissect the empirical studies' (Studies I-III) findings regarding excluded individuals' responses to others' eye gaze. After this, I will put these findings into a larger context, discussing what they, along with Study IV, suggest about social exclusion, social information processing, and emotion regulation. I will then discuss what Studies II and III revealed about effects of social inclusion and what implications these findings have.

4.1 Social exclusion and responses to eye gaze

4.1.1 Recovery from exclusion

In both experiments of Study I, social exclusion evoked the expected affective responses, as excluded participants, compared to included participants, reported lower basic need satisfaction immediately after the manipulation (consistent with earlier studies; Hartgerink et al., 2015). After this reflexive stage measurement, participants were shown a video of a person portraying direct or averted gaze, followed by another measurement of basic needs in the reflective stage. As the temporal need-threat model predicts (Williams, 2007), excluded participants' affect recovered between the two measurements. Most importantly, however, the gaze manipulation had no effect on recovery in either experiment. Excluded participants reported similar levels of basic need satisfaction in the reflective stage, irrespective of whether they were shown direct gaze or downward gaze videos. Notably, however, this result does not conclusively show that direct gaze has no effect on recovery at all, as the experiments may have been underpowered to detect small to medium effects. However, the two follow-up meta-analyses showed that even if this effect was not zero, it was nevertheless quite small. Simply diverting attention on another task moderates excluded individuals' basic need recovery significantly more than seeing direct gaze.

Of course, an intriguing question is why direct gaze had little or no effect on recovery from exclusion even though direct gaze is an affiliative cue which would be expected to increase feelings of connectedness (Hietanen et al., 2018; Wesselmann et al., 2012; Wirth et al., 2010). It is unlikely that this was because excluded participants experienced direct gaze as signaling threat instead of affiliation (Lamer et al., 2015). Previous research has shown that acknowledgment of any kind, even hostile acknowledgment, can ameliorate effects of exclusion (Rudert et al., 2017). Thus, even if excluded participants had experienced direct gaze as threatening, they might still have preferred this cue to being entirely ignored (cf. O'Reilly et al., 2014).

Another, more plausible explanation is that this affiliative cue does not make excluded individuals feel reconnected if it does not genuinely convey acknowledgment by another person. Previous research showing that acknowledgment or inclusion moderated recovery from exclusion involved real or ostensibly real interactions with other people (e.g., Gross, 2009; Rudert et al., 2017; Zwolinski, 2014). In Study I, however, participants were undoubtedly aware that they were not attended to by another person, as they viewed a video rather than a live person. Recent evidence shows that direct gaze seen in a video does not evoke similar physiological responses as direct gaze portrayed by a live person, even if attempting to vividly mentalize that the other person is physically present (Lyyra, Myllyneva, & Hietanen, 2018). One reason why pictorial and live faces do not always evoke similar responses in the perceiver (e.g., Hietanen et al., 2008; Pönkänen, Alhoniemi, Leppänen, & Hietanen, 2011) is the perceiver knowing that pictures do not look back (Myllyneva & Hietanen, 2015). Even affiliative cues may not facilitate recovery if the perceiver believes that they do not convey relevant information about one's inclusionary status. An important implication of this proposition is that direct gaze portrayed by a live person might facilitate recovery from exclusion, even though direct gaze in a video might not.

Testing this hypothesis would be rather challenging, however. Social interaction before the latter reflective stage would have to be limited to viewing of the live model's face to ensure that any additional interaction, such as a conversation, would not cause recovery of basic needs. Doing this in a natural way that would not allow participants to figure out the purpose of the study would be difficult. In addition, the live model would have to be presented to all participants immediately after the first, reflexive stage measurement to minimize spontaneous recovery between the measurement stages. This should either be done for several participants simultaneously, requiring multiple live models, or the experiment would have to be run for each participant individually. Both options would have been too resource intensive for the current study, and thus we did not test the hypothesis that a live person's direct gaze would facilitate recovery. However, this might be worth investigating in future research.

If recovery from exclusion were indeed only facilitated by cues that genuinely convey acknowledgment by another person, but not by pictorial acknowledgment cues, it would suggest that high-level cognitive processes are an integral part of the recovery. The excluded individual's affective state does not fluctuate depending on what types of stimuli they perceive as such, but rather depending on how they assess the situation and their social standing. Consistent with the notion that high-level cognitive appraisal is involved in recovery from exclusion, previous research has found that basic need recovery is thwarted if attributing exclusion to a feature salient to one's identity (gender), as compared to attributing exclusion to an arbitrary group membership (blue/green color of the character in Cyberball; Wirth & Williams, 2009). An important implication of this proposition is that manipulations may not influence recovery from exclusion similarly in all individuals, but the effects may be dependent on how the person appraises the situation. For instance, even if genuine eye contact would facilitate recovery, the effect might be diminished in individuals suffering from social anxiety, as they tend to view the cue as conveying threat instead of affiliation (Myllyneva et al., 2015; Wieser et al., 2009).

4.1.2 Gaze direction judgments

The main finding of Study II was that socially excluded participants, compared to control and inclusion groups, judged a narrower range of gaze directions as being pointed at them. Narrowing of the gaze cone may reflect avoidance motivation, as people devalue their relationships with others who are averting their gaze (Wirth et al., 2010) and may be inclined to avoid individuals looking away (cf. Hietanen et al., 2008). Avoidance motivation is associated with a tendency to interpret ambiguous facial expressions as angry (Nikitin & Freund, 2015), and similarly, excluded individuals' tendency to judge others as hostile or rejecting has been attributed to a motivation to avoid social interactions or to aggress (DeWall, Twenge, et al., 2009; Smart Richman, Martin, & Guadagno, 2016). The current results may suggest that a socially avoidant motivational response to exclusion also biases gaze direction judgments accordingly. Notably, however, we cannot conclusively determine whether narrowing of the gaze cone reflects avoidance motivation, as we did not measure participants' motivations directly, and thus there are alternative explanations for the finding. Firstly, excluded participants may have attempted to avoid self-relevant stimuli and the resulting increases in self-awareness, which excluded individuals may experience as aversive (cf. Hess & Pickett, 2010; Twenge, Catanese, & Baumeister, 2003). Alternatively, excluded participants may have aimed to avoid falsely judging a rejecting individual as affiliative, thus decreasing chances of further rejection (cf., error management theory; Johnson, Blumstein, Fowler, & Haselton, 2013).

Importantly, the study demonstrated that exclusion can influence gaze direction judgments differently in different contexts. A previous experiment employing similar methods found an opposite response, as excluded participants had a wider gaze cone than included participants (Lyyra et al., 2017). The factor that most likely explains the different outcomes in the two experiments is a difference in the social exclusion and inclusion manipulations. In the previous study, participants engaged in a ball-tossing game ostensibly with other participants present in the laboratory, whereas in the current study, the game was supposedly played online with people located elsewhere. Because participants were alone in the laboratory, they had no opportunity for affiliating with the excluders or others. According to the multimotive model proposed by Smart Richman and Leary (2009), individuals are likely to respond to exclusion in a socially avoidant way if there is no opportunity for reaffiliation (see also Cuadrado et al., 2015; DeWall & Richman, 2011; Romero-Canyas et al., 2010). As a caveat, however, we cannot definitively ascertain whether this factor accounts for the differing effects in the two studies, as the possibility for reaffiliation was not manipulated within the experiment. We conducted an additional small-scale experiment (N = 42) in which we investigated if exclusion vs. inclusion in Cyberball influences self-reported affiliation-, avoidance-, and aggression-related motivations differently depending on whether the interaction partners are present in the laboratory or not, but the results were inconclusive because the manipulations had no effects on participants' responses in the questionnaires (see the original publication of Study II for details of this experiment). To provide support for the hypothesis that possibility for reaffiliation moderates the effects of exclusion on gaze direction judgments, it should be demonstrated that widening and narrowing of the gaze cone occurs in the presence and absence of reaffiliation opportunities, respectively. However, this would require an experiment with a very large sample size, as both participants' inclusionary status and reaffiliation opportunities would have to be manipulated within the same experiment. Running this kind of experiment with sufficient statistical power to detect effects on the gaze cone was outside the scope of the current study, and thus further research on the issue is still required.

4.1.3 Attentional disengagement

The results of Study III showed that response times in identifying peripheral stimuli were longer on direct gaze trials vs. downward gaze trials only in the social inclusion group, but not in the social exclusion group or the non-social control group. There were no significant differences in response times between the groups on either direct or downward gaze trials. Thus, social exclusion did not delay attentional disengagement from faces with direct gaze, contrary to what was predicted based on earlier studies reporting that exclusion increased allocation of attention to faces showing affiliative facial expressions (e.g., DeWall, Maner, & Rouby, 2009), and that exclusion enhanced attention shifts triggered by averted gaze (Wilkowski et al., 2009). This was not due to the manipulation failing to evoke feelings of exclusion, as excluded participants reported experiencing lower basic need satisfaction and mood, and more pain than the other groups.

There are two important distinctions between Study III and earlier studies on effects of exclusion on attention to faces (e.g., Buckner et al., 2010; DeWall, Maner, & Rouby, 2009; Tanaka & Ikegami, 2015; Tuscherer et al., 2015), suggesting possible interpretations for the finding. Firstly, this was the first study to investigate the effects of exclusion on attention to faces portraying direct gaze. Previous research in this field has mostly investigated attention allocation towards different facial expressions. A possible interpretation is that people may allocate attention towards smiling faces but not towards direct gaze faces as a response to exclusion, possibly because they may see a smile as a more affiliative cue than direct gaze on a neutral face. Secondly, this was the first reported experiment in this field to examine the effects of exclusion on attentional disengagement rather than visual search, or the stages of attentional shifting or engagement. It has been proposed that attentional biases to affiliative cues help excluded individuals in detecting and identifying socially relevant stimuli (Shilling & Brown, 2016). Detection and identification might not be facilitated by delayed disengagement from the stimuli, and thus exclusion might not exert its influence at this component of attention. However, both these interpretations are speculative at this point. Future studies could provide more insight into which kinds of cues excluded individuals allocate their attention towards, and which attentional processes exclusion modulates. It could be investigated whether exclusion enhances the tendency to shift attention towards faces showing direct gaze (e.g., Böckler, van der Wel, & Welsh, 2014; von Grünau & Anston, 1995), or slows down disengagement from faces with different facial expressions.

Although it was secondary to the main aims of this study, it was noteworthy that direct gaze did not generally influence response times to the peripheral stimuli. Thus, Study III did not replicate an earlier result by Senju and Hasegawa (2005) even though both studies used a very similar attentional disengagement task and the current study had more statistical power. Our finding is somewhat consistent with a few other recent studies reporting that direct gaze did not influence attentional disengagement from a face. It has been reported that saccadic latencies from face pictures to peripheral stimuli were similar on direct and downward gaze trials (Dalmaso, Castelli, & Galfano, 2017; but see Ueda et al., 2014). Another experiment even found shorter, rather than longer, response times to peripheral targets when live faces with direct gaze, compared to downward gaze, were presented in the fixation (Hietanen, Myllyneva, Helminen, & Lyyra, 2016). Thus, Study III contributes to a growing body of evidence suggesting that direct gaze might not generally delay attentional disengagement from a face, contrary to what has been argued earlier.

4.1.4 Social information processing and emotion regulation

The literature review in Study IV suggested that exclusion influences social information processing in various different ways, such as modulating attention allocation, affective evaluations, and even early face processing. These changes in social cognitive processes presumably aid excluded individuals in regulating social needs and mood. However, it seems unlikely that excluded individuals attend to affiliative face pictures (Buckner et al., 2010; DeWall, Maner, & Rouby, 2009) or evaluate ambiguous face pictures positively (Lyyra et al., 2017; Maner et al., 2007) to enhance their affective state as such. This would not be a particularly efficient strategy for directly facilitating recovery from exclusion, considering that Study I showed that a simple distraction would alleviate distress significantly more than viewing a (pictorial) cue of acknowledgment. Rather, such social cognitive biases might be related to individuals' motivations and behavior, and could influence, for instance, whom they choose to approach or avoid.

From this perspective, it is understandable why exclusion can, under some conditions, also evoke effects that presumably foster socially avoidant behavior, such as narrowing of the gaze cone (Study II), or increased attention towards threatening faces (Tanaka & Ikegami, 2015; Tuscherer et al., 2015). If viewing direct gaze had a strong influence on recovery from exclusion, it would be adaptive to show widening of the gaze cone (Lyyra et al., 2017) regardless of the situation. However, different kinds of motivational responses and associated social cognitive changes could be advantageous in different situations. A socially avoidant response may generally seem counterproductive, but if the individual deems reaffiliation implausible, this motivational tendency could be an effective way of protecting oneself from further rejection, at least in the short term. In the long term, however, such tendencies could be deleterious, as they might further increase isolation and its associated problems (Cacioppo & Hawkley, 2009).

As these changes in social information processing may be an important part of excluded individuals' emotion regulation, it would be useful to form a detailed picture of how the effects emerge. A central finding of Study IV was that many studies in this field have been rather vague in differentiating the precise cognitive mechanisms mediating the effects of exclusion on social information processing. It is not clear, for instance, whether enhanced memory for social information or enhanced facial expression recognition accuracy are caused by changes in memory or perceptual processes, respectively, or if these effects reflect, for instance, altered attention allocation, such as increased attention to the tasks or specific features of the stimuli. Notably, the present empirical studies also have the same limitation, and thus we cannot for instance determine the cognitive processes mediating the altered gaze direction judgments in Study II. Such questions could be investigated in the future by employing additional control tasks that allow ruling out alternative explanations for the results (for examples, see e.g., Baumeister, Twenge, & Nuss, 2002; Cohen, Alvarez, & Nakayama, 2011; Firestone & Scholl, 2016).

Future research should also examine whether specialized mechanisms mediate the effects of exclusion on attention as the impactful social monitoring system hypothesis posits (Pickett & Gardner, 2005; Pickett et al., 2004). It would be important to stringently test predictions of the hypothesis, such as the idea that exclusion increases allocation of attention to social information generally. It would also be important to show that the reported information processing effects are specific to social stimuli, and that similar effects are not observed for non-social stimuli (as done in, e.g., Capellini et al., 2019; Claypool & Bernstein, 2014; Gardner et al., 2000). However, even these tests of the hypothesis would not allow determining whether the attentional effects were driven by an inherent social monitoring system, as similar responses could also be related to learned emotion regulation strategies (Todd et al., 2012). Future research could more directly examine whether there are specialized systems for mediating the effects of exclusion on attention, by investigating the neural basis of the hypothesized system.

Finally, it would be interesting to examine whether the various social information processing effects are driven by voluntary or involuntary processes. Many studies in this field have investigated processing stages that are partly under voluntary control, such as evaluative judgments, or late stages of attention deployment, when attention can be voluntarily oriented. Future research could investigate whether exclusion also modulates involuntary processes, such as automatically triggered affective responses (Murphy & Zajonc, 1993) or early, involuntary attentional shifts (Carrasco, 2011). Changes at these early stages may shape responding at later, conscious stages, and thus research on these questions could illuminate whether the social information processing effects reflect intentional or automatized emotion regulation (see also DeWall et al., 2011).

4.2 Effects of social inclusion

We made three noteworthy findings regarding the effects of social inclusion in Studies II and III. First, there was no evidence that social inclusion influenced affect, as there were no statistically significant differences on self-reported basic need satisfaction, mood, or pain between inclusion and control groups in either experiment. Interestingly, there was a marginal difference between inclusion and control groups in basic need satisfaction in Study III, possibly reflecting a slightly enhanced affective state in the inclusion group (consistent with results by Blackhart et al., 2009). However, strong conclusions should not be drawn from this finding because the difference was not statistically significant, and because the result differed from Study II. Our findings were mostly consistent with earlier studies suggesting that social inclusion in Cyberball does not evoke strong affective responses (Dvir et al., 2018; Riva et al., 2014). Nevertheless, the possibility cannot conclusively be ruled out, as our experiments may have been underpowered to detect small effects.

A second notable finding was that, in Study II, social inclusion had no effect on gaze direction judgments, as the gaze cone was equally wide in the inclusion and control groups. Previous research has not been able to disentangle effects of exclusion and inclusion on gaze direction judgments due to using inclusion as the only control task (Lyyra et al., 2017), but the present results suggest that the difference between excluded and included participants is indeed driven by exclusion.

The third and most intriguing finding was that, in Study III, social inclusion influenced attentional disengagement from the faces. As mentioned earlier, the response times to peripheral stimuli were longer on direct gaze trials than downward gaze trials in the social inclusion group, but not in the other groups. Because the result was not anticipated a priori, it is difficult to ascertain what the effect reflects. A possible interpretation is that an inclusive social interaction activated cognitive processes related to affiliation, which made included participants experience direct gaze as a particularly salient cue (cf. McCrackin & Itier, 2018) and thereby increasing allocation of attention towards faces with direct gaze. However, further research would be needed to fully understand the unexpected result.

An important reason for investigating the effects of inclusion in Cyberball is to ascertain whether inclusion is a valid control condition when investigating effects of exclusion. Cyberball has been used in hundreds of studies, and the vast majority of these studies have used social inclusion as the only control condition, assuming any between-group differences to be caused by exclusion (Hartgerink et al., 2015; Williams & Jarvis, 2006). This assumption was previously challenged by a finding that inclusion, but not exclusion, increased interest in mating, when compared to a no-manipulation condition (Brown et al., 2009). Our results provide further evidence that some of the differences between excluded and included participants are driven by inclusion. Thus, future research using Cyberball and other exclusion manipulations would benefit from including non-social control conditions to be able to disentangle the effects of exclusion from the effects of inclusion. Importantly, however, we are not suggesting that the earlier findings of the effects of exclusion on social cognitive processes, reviewed in Study IV, were driven by the used control manipulations. While a significant portion of these studies used social inclusion or acceptance as the only control condition (e.g., Bernstein et al., 2014; Sacco et al., 2011; Tanaka & Ikegami, 2015), similar effects had also been reported in studies using other types of controls (e.g., Bernstein et al., 2008; DeWall, Maner, & Rouby, 2009; van Bavel, Swencionis, O'Connor, & Cunningham, 2012).

The non-social ball game used in the present research would be a useful control manipulation for future Cyberball studies as well. It more closely resembles the standard exclusion and inclusion conditions than non-social controls used in previous studies, such as a no-manipulation condition (Brown et al., 2009) or tasks involving mental visualization of nature (Dvir et al., 2018; Riva et al., 2014), the latter having the additional limitation that natural scenes can evoke positive affective responses (Ulrich et al., 1991). However, while the current control task is suitable for disentangling the effects of exclusion and inclusion, it cannot control for all potentially relevant factors. For instance, differences between exclusion and control groups could result from reductions in mood, rather than reflecting aversive social experiences specifically. Therefore, ruling out mood effects would require an affectively negative non-social control condition (cf. Maner et al., 2007). Another potentially relevant factor this task cannot control for is expectancy violation. Some of Cyberball's effects on brain activity may be driven by the exclusion condition violating participants' expectations, resulting in increased processing of cognitive conflict (Somerville et al., 2006).

4.3 Limitations

One potential limitation of the empirical studies (Studies I-III) was that the exclusion manipulation aroused suspicion in participants, resulting in several of them inferring that they were being deceived in the experiment. The problem with participants figuring out the deception is that it could diminish the effects of the manipulation, or alternatively demand characteristics could drive these participants' responding (Nichols & Maner, 2008). In the current studies (except in Study I, Exp. 2), the issue was dealt with by removing suspicious participants from the analyses. It is noteworthy, however, that this approach could potentially introduce new issues, such as skewing of the final sample due to conditional exclusion of participants from analyses. The issue of suspicion may be difficult to fully solve in social exclusion studies that involve deceiving participants. This is because expectancy violation, inherent to many social exclusion experiences (Wesselmann, Wirth, & Bernstein, 2017), likely increases cognitive processing of the incident (cf. Somerville et al., 2006), allowing some excluded participants to figure out that they are being deceived. This may not be an issue when investigating reflexive affective responses, because the initial reaction to exclusion is similar regardless of whether the individual thinks the situation is genuine or not (Zadro et al., 2004), but dealing with suspicion becomes important when investigating later responses, as they are moderated by the individual's inferences about the situation (Smart Richman & Leary, 2009).

Another limitation of the empirical studies was the lack of non-social control stimuli in the eye gaze manipulations and tasks. In Studies I and III, faces with direct gaze were compared to faces with downward gaze, but not to any other stimuli. Thus, it is possible that the faces as such, regardless of their gaze direction, had some effect on the measurements of interest. For instance, in Study I, perception of faces may have had some effect on basic need recovery so that direct gaze did not offer any additional benefit. Similarly, exclusion could have influenced disengagement from faces in general in Study III. Even though no differences in response times between the exclusion group and the control group were found, it is possible, for instance, that exclusion delayed attentional disengagement from faces, but the effect was cancelled out by enhanced arousal evoked by exclusion (Kelly, McDonald, & Rushby, 2012). Moreover, because non-social control stimuli were not used in Study II, we cannot determine whether narrowing of the gaze cone reflects altered responding to eye gaze specifically. Showing that exclusion modulates judgments of gaze directions, but not judgments of directions of non-social, motivationally irrelevant stimuli such as arrows, would provide further evidence that changes in the gaze cone reflect changes in motivational states.

Finally, a limitation of the present research was the relatively modest sample size in the empirical studies. While the sample sizes were comparable to many other studies in this field (e.g., DeWall, Maner, & Rouby, 2009; Lyyra et al., 2017; Xu et al., 2015), the experiments may have been underpowered to detect smaller effects. Null findings regarding effects of the exclusion and inclusion manipulations should therefore be interpreted cautiously.

4.4 Concluding remarks

The present research described what is currently known about effects of exclusion on processing of social information, and extended this literature by investigating excluded and included individuals' responses to others' eye gaze. Contrary to our expectations, direct gaze did not alleviate distress caused by exclusion, and excluded participants did not show difficulties in disengaging attention from direct gaze, suggesting that socially excluded individuals may not respond to direct gaze particularly strongly. Information conveyed by others' eye gaze is nevertheless important for navigating different kinds of social environments, and this may be especially true for individuals whose social status is threatened. Exclusion alters gaze direction judgments, and these changes are modulated by situational factors, possibly reflecting excluded individuals' inferences of the situation and their reaffiliation opportunities.

Future research could investigate mechanisms driving the effects of exclusion on social cognitive processes. It would be interesting to determine if effects such as altered gaze direction judgments or attention allocation reflect changes only in high-level voluntary processes, or also in earlier, automatic processes. Moreover, future research could examine boundary conditions for elicitation of these different effects, allowing researchers to form better understanding on why exclusion influences social information processing differently in different people (Tanaka & Ikegami, 2015; Tuscherer et al., 2015). This would be important, as social cognitive biases, such as a tendency to attend to threatening cues and to judge others as hostile, mediate the effect of exclusion on aggressive behavior (Dodge et al., 2003) and are an important determinant of problems such as depression, anxiety and loneliness (Cacioppo & Hawkley, 2009; Leppänen, 2006; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Seemingly maladaptive responses to exclusion, such as aggression or social withdrawal, have been considered puzzling (Gerber & Wheeler, 2009; Wesselmann et al., 2015). However, they may become understandable when considering how excluded individuals view the world around them. For a person who views the environment as hostile and threatening, withdrawal or aggression may seem like the only way to cope. A person who instead responds to exclusion by seeking affiliative cues is more likely to act in ways that will allow restoring a sense of belonging.

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PUBLICATIONS

PUBLICATION
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When a look is not enough: No evidence for direct gaze facilitating recovery after social exclusion

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WHEN A LOOK IS NOT ENOUGH: NO EVIDENCE FOR DIRECT GAZE FACILITATING RECOVERY AFTER SOCIAL EXCLUSION

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Direct gaze has been suggested to convey inclusion. We hypothesized that receiving direct gaze could alleviate distress caused by social exclusion. In two experiments, participants were first either included or excluded, and then shown a video of a person portraying either direct or downward gaze. Basic need satisfaction was measured immediately after the exclusion manipulation and after viewing the eye gaze stimuli. In Experiment 1, after watching the one-minute eye gaze video and "mentally visualizing" an interaction with the person, basic need satisfaction of excluded participants had recovered completely, regardless of the gaze direction. In Experiment 2, participants were shown shorter eye gaze videos in which the person gave task instructions. Participants recovered partially by the delayed measurement, but gaze direction did not moderate this recovery. These results indicate that seeing direct gaze has little or no effect on recovery after social exclusion.

Keywords: ostracism, eye gaze, eye contact

Social exclusion is a common phenomenon that threatens the fundamental human need to belong (see Baumeister & Leary, 1995; Williams, 2007). Social exclusion can take many forms, such as ostracism (Williams, 2007), rejection (e.g., Maner, DeWall, Baumeister, & Schaller, 2007), and discrimination (e.g., Smart Richman,

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Martin, & Guadagno, 2016).[1] Even short-term exclusion is distressing, as it lowers mood (Gerber & Wheeler, 2009), thwarts satisfaction of basic social needs of belonging, control, meaningful existence, and self-esteem (Hartgerink, van Beest, Wicherts, & Williams, 2015), and can even be painful (e.g., Eisenberger, Lieberman, & Williams, 2003). According to the temporal need-threat model (e.g., Williams, 2007), this immediate, reflexive reaction to exclusion is followed by a delayed reflective reaction, during which excluded individuals attempt to fortify thwarted basic needs, usually by seeking reconnection with others. This idea is supported by findings that excluded participants, compared to controls, are more interested in forming new relationships and working with others, and rate others as nicer, friendlier, and more attractive (Maner et al., 2007). To promote their relational status, excluded individuals may work harder (Williams & Sommer, 1997), and in order to fit in, they may comply (Riva, Williams, Torstrick, & Montali, 2014), conform (Williams, Cheung, & Choi, 2000), imitate others' body movements (Lakin, Chartrand, & Arkin, 2008), and buy specific products (Mead, Baumeister, Stillman, Rawn, & Vohs, 2011).

A few studies have examined how affiliation with others moderates the affective impact of social exclusion. Being accompanied by a close other (Teng & Chen, 2012) or even a dog (Aydin et al., 2012) during exclusion can attenuate distress in the immediate, reflexive stage. Recovery from exclusion can also be moderated by successful reaffiliation. In one study, a friendly interaction with an experimenter after exclusion reduced aggression more than a neutral interaction (Twenge et al., 2007). In another study, excluded participants showed greater recovery of self-esteem and affect after chatting with a peer online than after playing a solitary game of Tetris (Gross, 2009). Zwolinski (2014) found that an inclusive interaction alleviated affective distress after exclusion more than the passing of time.

As affiliation can ameliorate aversive outcomes of exclusion, excluded individuals could be highly attentive to affiliative cues (see also Shilling & Brown, 2016). Indeed, attention to smiling faces is increased in participants expecting exclusion (DeWall, Maner, & Rouby, 2009), as well as in participants excluded from a virtual ball-tossing game (Xu et al., 2015). In one study, excluded participants were more accurate than included participants at distinguishing between happy and angry faces (Sacco, Wirth, Hugenberg, Chen, & Williams, 2011). In another study, reflecting on exclusion made participants more accurate at distinguishing genuine smiles from smiles that were not genuine (Bernstein, Young, Brown, Sacco, & Claypool, 2008).

Not only facial expressions of positive affect, but also direct gaze could be an affiliative cue for excluded individuals. Several authors have suggested that direct gaze signals inclusion (Wesselmann, Cardoso, Slater, & Williams, 2012; Wirth,

1. While ostracism, rejection, discrimination, and other related concepts have their own distinct definitions, they have a lot in common (see e.g., Smart Richman & Leary, 2009). There may be important distinctions between these phenomena, but because the psychological outcomes are relatively similar, the terms are often used interchangeably (see e.g., Williams, 2007). Discussing differences between these concepts is beyond the scope of the current article, and thus we will simply use the umbrella term social exclusion to refer to all related phenomena.

Sacco, Hugenberg, & Williams, 2010). It has been reported that a brief eye contact with a passerby can increase feelings of connectedness (Wesselmann et al., 2012), and being in eye contact (vs. seeing averted gaze) increases the perceived value of the relationship (Wirth et al., 2010). Seeing another person portraying direct gaze has also been shown to elicit positive affective reactions in the observer (Chen, Helminen, & Hietanen, 2017; Chen, Peltola, Ranta, & Hietanen, 2016), and activate brain mechanisms related to approach motivation (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008). Because direct gaze communicates that one is being attended to (see Conty, George, & Hietanen, 2016), it could be an especially significant cue for excluded individuals. Excluded participants, compared to included participants, have been shown to look more in the eyes of their interaction partners, suggesting that they attempt to make eye contact in order to get reintegrated in the interaction (Böckler, Hömke, & Sebanz, 2014). In a recent study, excluded participants, compared to included participants, accepted a wider range of gaze directions as being direct, possibly because seeing direct gaze could make them feel reconnected (Lyyra, Wirth, & Hietanen, 2017). It seems, thus, that excluded individuals seek direct gaze, possibly as a coping strategy that could make them feel reconnected. If direct gaze can convey inclusion, it would be expected to alleviate the aversive effects of exclusion as well.

Even though direct gaze can signal inclusion and elicit various positive reactions, it should be noted that it can also be perceived as threatening (see Kleinke, 1986). This is especially true when direct gaze is accompanied with an angry facial expression (see Adams & Kleck, 2005). Seeing angry faces portraying direct gaze can lower self-esteem (Lamer, Reeves, & Weisbuch, 2015), and thus seeing threatening faces could further bolster the adverse effects of social exclusion. On the other hand, recent research indicates that even negative feedback can alleviate distress caused by social exclusion (Rudert, Hales, Greifeneder, & Williams, 2017). An excluded individual may prefer even negative attention to being ignored altogether (see also O'Reilly, Robinson, Berdahl, & Banki, 2014). Thus, even if direct gaze were interpreted as a sign of threat, it could be expected to alleviate the adverse effects of exclusion.

The purpose of the current study was to find if receiving direct gaze could alleviate distress caused by social exclusion. In two experiments, participants' feelings of exclusion were manipulated using Cyberball (Williams & Jarvis, 2006), a virtual ball-tossing game in which participants are either included or ostracized (i.e., ignored and excluded). After the exclusion manipulation, the participants were shown a video of a person portraying either direct or downward gaze. Participants' basic need satisfaction was measured immediately after the manipulation (reflexive stage) and after viewing the eye gaze stimuli (reflective stage). We hypothesized that after the exclusion manipulation, in the reflexive stage, excluded participants would report lower basic need satisfaction than included participants, indicative of affective distress (see Gerber & Wheeler, 2009). Based on the temporal need-threat model (Williams, 2007), and earlier research on recovery of basic needs after exclusion (e.g., Wirth & Williams, 2009), we hypothesized that excluded participants would show recovery by the delayed, reflective stage measurement, but would still report more distress than included participants. Our main hypothesis was that excluded participants shown a video with direct gaze would report less distress in the reflective stage than excluded participants shown a video with downward gaze.

EXPERIMENT 1

In Experiment 1, participants were included or socially excluded in a four-player game of Cyberball, a ball-tossing game used as a social exclusion manipulation (see Williams & Jarvis, 2006). After Cyberball, participants were shown a one-minute video of a person portraying either direct or downward gaze.

METHOD

Participants. The participants were 80 adults (21 males, M_{age} = 25.6, SD_{age} = 6.0) with no diagnosed psychiatric or neurological disorders. They were rewarded with course credit or a movie ticket. Participants signed a form of informed consent. An ethical statement for the study was obtained from the Ethics Committee of the Tampere Region.

Participants were randomly assigned to be either included or excluded in Cyberball, and to be shown a video with either direct or downward gaze. The sample size of 80 participants was determined before data collection based on the suggestion of 20 participants per cell (see Simmons, Nelson, & Simonsohn, 2011). To find if this sample size has sufficient power to detect the interaction of interest, a power analysis was conducted using G*Power 3.1 software (Faul, Erdfelder, Lang, & Buchner, 2007). We were interested in how the gaze direction manipulation modulates recovery of excluded participants, and thus we simplified the analysis by focusing on this most important interaction (however, see Muller, LaVange, Ramey, & Ramey, 1992 for caveats for such an approach). We estimated the required sample size for a 2 (Gaze Direction, between-subjects factor) × 2 (Recovery Stage, within-subjects factor) design with only the exclusion group. Using very similar experimental designs as the present study, but with different manipulations, previous research has found the comparable interaction of interest to yield effect sizes ranging from η^2_p = .1 (Hales, Wesselmann, & Williams, 2016) to η^2_p = .29 (Molet, Macquet, Lefebvre, & Williams, 2013). Anticipating an effect size of η^2_p = .1, power of .80, and p = .05 (Cohen, 1992), and a correlation coefficient of .13 between the two measurements (Hales et al., 2016), the power analysis suggested 34 participants in the exclusion group (17 participants per cell), and thus a total sample size of 68.

Apparatus and Stimuli. All materials were presented on a 19-inch LCD monitor with a resolution of 1280 × 1024 and a refresh rate of 60 Hz. E-Prime® 2.0 software was used to control the stimulus presentation and to acquire data. Cyberball was presented on Firefox 17.0.5. Internet browser. Participants wore acoustic earmuffs to prevent distracting noises.

For the eye gaze manipulation, we filmed one-minute video clips portraying eight different individuals (four females) with direct and downward gaze. The models had a neutral facial expression, but were instructed to maintain a slight muscle tonus in the lower part of their faces to avoid a sullen face. Minor head movements and eye blinks were allowed. The resolution of the videos was 1024 × 768. The faces were approximately 13.5 cm (11°) × 18.5 cm (15°) in size. The genders and identities of the models were counterbalanced across all conditions and genders of the participants.

Procedure. Participants arrived in the laboratory in groups of four. Participants were told that the purpose of the experiment was to study "mental visualization," and that they would do mental visualization tasks. To enhance the cover story, participants completed a bogus mental visualization questionnaire. After this, they played a game of Cyberball 4.0 (Williams & Jarvis, 2006) that lasted for 45 throws. They were told to mentally visualize the interaction in detail. Participants were led to believe that the game was played with the other participants through a local area network. In reality, the course of the game was predetermined. Participants were randomly assigned to inclusion and exclusion groups. Participants in the inclusion group received approximately 25% of the throws, and participants in the exclusion group only received the ball three times, once from each character in the beginning of the game, and then never again.

Immediately after Cyberball (reflexive stage), participants completed a questionnaire measuring the four basic social needs (belonging, self-esteem, meaningful existence, and control), mood, and pain (e.g., Wirth & Williams, 2009). The questionnaire was on a 1–5 Likert scale. For the sake of brevity, results of the mood and pain measurements are presented in Supplementary Materials.[2] The basic need items were reverse-scored where necessary, combined and averaged to create an index of basic need satisfaction ($\alpha = .97$). As a manipulation check, participants were asked to assess the percentage of all ball tosses they received. Participants were also asked to indicate whether they were ignored and excluded during the game.

After the questionnaire, participants were shown the one-minute eye gaze video. In both the inclusion and exclusion groups, half of the participants saw the video portraying a model with direct gaze, and half were shown the video with downward gaze. To preserve the cover story, participants were asked to mentally visualize an interaction with the person in the video. The manipulation was followed by the reflective stage questionnaire. The questionnaire was the same as in the reflexive stage, but instead of asking participants to rate their feelings during the game, they were asked to answer based on what they felt *right now* ($\alpha_{\text{basic needs}} = .94$). As a manipulation check, participants were asked to assess the percentage of the time the person in the video was looking directly at them. Participants were also asked to indicate whether they were ignored and excluded during the video.

After all participants were finished with the experiment, they were given an opportunity to express doubts about the experiment, and to ask questions. After this, they were thoroughly debriefed. At the end of the experiment, we measured

2. Supplementary Materials can be obtained from http://www.uta.fi/yky/en/research/hip/publications/When_a_look_is_not_enough_Supplementary_Materials.pdf

participants' situational self-awareness, personality traits, and trait self-esteem. These measurements and their results are presented in Supplementary Materials.

Data Analysis. Four participants (two males) were excluded from the analyses, one for withdrawing the consent and three for expressing suspicion concerning the Cyberball manipulation before debriefing. The analyses yielded similar results with or without these data exclusions. The final sample consisted of 76 participants ($n_{\text{included, direct}} = 20$, $n_{\text{included, downward}} = 20$, $n_{\text{excluded, direct}} = 18$, $n_{\text{excluded, downward}} = 18$).

Basic need scores were subjected to a three-way mixed design ANOVA with Inclusionary Status (included/excluded) and Gaze Direction (direct/downward) as between-subject factors, and Recovery Stage (reflexive/reflective) as a within-subject factor. Significant interactions were broken down with *t*-tests. When a Levene's test for equality of variances revealed unequal variances between groups, Welch's *t*-test was used (for similar analytic strategies, see Hales et al., 2016; Wirth & Williams, 2009).

RESULTS AND DISCUSSION

Manipulation Checks. After the reflexive stage measurements, excluded participants reported receiving less of the total number of tosses ($M = 9.6\%$, $SD = 8.5$) than included participants ($M = 28.2\%$, $SD = 13.0$), $t(74) = 7.30$, $p < .001$, $d = 1.69$, 95% CI [13.49, 23.63], in the Cyberball game. Excluded participants also indicated being more ignored ($M_{\text{excluded}} = 4.11$, $SD_{\text{excluded}} = 0.78$, $M_{\text{included}} = 1.55$, $SD_{\text{included}} = 0.92$), $t(74) = 13.12$, $p < .001$, $d = 3.00$, 95% CI [-2.95, -2.17], and excluded ($M_{\text{excluded}} = 4.17$, $SD_{\text{excluded}} = 0.81$, $M_{\text{included}} = 1.33$, $SD_{\text{included}} = 0.66$), $t(74) = 16.87$, $p < .001$, $d = 3.85$, 95% CI [-3.18, -2.51], than included participants. After the reflective stage measurements, participants in the direct gaze group reported that the person in the video was portraying more direct gaze ($M = 85.5\%$, $SD = 21.6$) than participants in the downward gaze group ($M = 5.6\%$, $SD = 17.6$), $t(74) = 17.70$, $p < .001$, $d = 4.06$, 95% CI [70.97, 88.98]. Compared to the direct gaze group, participants in the downward gaze group indicated being more ignored ($M_{\text{downward}} = 3.42$, $SD_{\text{downward}} = 1.43$, $M_{\text{direct}} = 2.45$, $SD_{\text{direct}} = 1.47$), $t(74) = 2.94$, $p = .004$, $d = 0.67$, 95% CI [-1.64, -0.31], and excluded ($M_{\text{downward}} = 2.82$, $SD_{\text{downward}} = 1.37$), $t(74) = 2.73$, $p = .008$, $d = 0.63$, 95% CI [-1.41, -0.22].

Basic Need Satisfaction. For basic need scores in each experimental group, see Table 1. A three-way mixed design ANOVA revealed a main effect of Inclusionary Status on basic need satisfaction, $F(1, 72) = 44.48$, $p < .001$, $\eta^2_p = .38$, 95% CI [0.58, 1.07]. Excluded participants reported lower basic need satisfaction ($M = 2.75$, $SD = 0.55$) than included participants ($M = 3.58$, $SD = 0.52$). A main effect of Recovery Stage was also found, $F(1, 72) = 22.79$, $p < .001$, $\eta^2_p = .24$, 95% CI [-0.71, -0.16]. Basic need satisfaction was higher in the delayed, reflective stage ($M = 3.40$, $SD = 0.73$) than in the immediate, reflexive stage ($M = 2.97$, $SD = 1.04$). The main effect of Gaze Direction was not significant, $F(1, 72) = 1.57$, $p = .214$, $\eta^2_p = .02$, 95% CI [-1.54, 0.46].

The main effects were qualified by an Inclusionary Status × Recovery Stage interaction, $F(1, 72) = 69.30$, $p < .001$, $\eta^2_p = .49$. Immediately after the exclusion manipulation, in the reflexive stage, excluded participants reported significantly lower basic need satisfaction than included participants, $t(74) = 11.34$, $p < .001$, *d*

TABLE 1. Basic Need Scores For Each Experimental Group In Both Recovery Stages (Experiment 1)

	Direct gaze *M* (*SD*)	Downward gaze *M* (*SD*)	Overall mean *M* (*SD*)
Reflexive stage			
Included	3.84 (0.57)	3.67 (0.66)	3.75 (0.61)
Excluded	2.16 (0.63)	2.04 (0.69)	2.10 (0.66)
Overall mean	3.04 (1.04)	2.90 (1.06)	2.97 (1.04)
Reflective stage			
Included	3.45 (0.72)	3.35 (0.79)	3.40 (0.75)
Excluded	3.53 (0.71)	3.29 (0.72)	3.41 (0.71)
Overall mean	3.49 (0.71)	3.32 (0.75)	3.40 (0.73)

Note. The measurements were made on a 1 (not at all) to 5 (extremely) scale

= 2.60, 95% CI [1.36, 1.94], showing that they felt excluded as expected. Excluded participants reported higher basic need satisfaction in the reflective stage than in the reflexive stage, $t(35) = 9.58$, $p < .001$, $d = 1.91$, 95% CI [-1.59, -1.03], indicating significant recovery, whereas included participants reported lower basic need satisfaction in the reflective stage than in the reflexive stage, $t(39) = 2.51$, $p = .016$, $d = 0.51$, 95% CI [0.07, 0.64]. Importantly, however, in the reflective stage, the two groups did not differ in basic need satisfaction, $t(74) = 0.07$, $p = .948$, $d = 0.01$, 95% CI [-0.35, 0.32], suggesting the effect of the exclusion manipulation had dissipated by the second measurement in the exclusion group. There were no other interactions (largest F was for Inclusionary Status × Gaze Direction × Recovery Stage interaction, $F(1, 72) = 0.20$, $p = .654$, $\eta^2_p = .00$). Most importantly, excluded participants shown direct versus downward gaze videos reported similar levels of basic need satisfaction in the delayed, reflective stage, $t(34) = 0.99$, $p = .328$, $d = 0.33$, 95% CI [-0.25, 0.72].

We did not find support for our hypothesis that seeing direct gaze could alleviate distress caused by social exclusion, but we could not refute it, either. The complete recovery of excluded participants can possibly be attributed to the distraction caused by the video viewing task, and the concurrent mental visualization task. A one-minute break after exclusion in Cyberball is enough to allow for some, but not complete, recovery of basic needs and mood (Wirth & Williams, 2009). However, previous research has also shown that when excluded participants are distracted with a task in which they are asked to observe changes in video clips, they can completely recover in less than two minutes (Wesselmann, Ren, Swim, & Williams, 2013). The eye gaze manipulation, and the concurrent mental visualization task, may have distracted the participants in our experiment, allowing for complete recovery of basic needs. Alternatively, excluded participants may have completely recovered because the mentally visualized interaction was sufficient to make them feel reconnected.

EXPERIMENT 2

In Experiment 2, participants were, again, included or excluded in Cyberball. To ensure participants would not recover completely by the delayed, reflective stage, we designed a different eye gaze manipulation. During the experiment, the participants were given instructions in video format by a model. After the reflexive stage measurements completed immediately after the exclusion manipulation, the model gave instructions while portraying either direct or downward gaze. Unlike in Experiment 1, there was no concurrent mental visualization task, to render the gaze direction manipulation less distracting.

METHOD

Participants. The participants were 82 adults (20 males, M_{age} = 24.8, SD_{age} = 6.3) with no diagnosed psychiatric or neurological disorders. They were rewarded with course credit or a movie ticket. Participants signed a form of informed consent.

Participants were, again, randomly assigned to be either included or excluded in Cyberball, and to be shown a video with either direct or downward gaze. One participant (included in Cyberball, shown a video with downward gaze) was excluded from the analyses for being familiar with Cyberball. The analyses yielded similar results with or without this data exclusion. The final sample consisted of 81 participants ($n_{\text{included, direct}}$ = 20, $n_{\text{included, downward}}$ = 18, $n_{\text{excluded, direct}}$ = 21, $n_{\text{excluded, downward}}$ = 22).

Apparatus and Stimuli. The apparatus was identical to Experiment 1, except participants wore acoustic earmuffs with integrated audio instead of standard acoustic earmuffs.

We filmed short video clips portraying faces of two different models (female and male). The first video, which lasted for 23 seconds, was shown before Cyberball to familiarize participants with the model. The model repeated the instructions for Cyberball in a neutral tone, and also reminded participants to mentally visualize the interaction. The model alternated between looking at the camera (direct gaze; 50% of the time) and looking down (50% of the time). For the eye gaze manipulation video, shown between the reflexive and reflective stage measurements, two clips for each model were filmed. The models were instructed to act identically in each video, except for the gaze direction: they looked directly at the camera in one video, and down in the other.[3] The model gave instructions for the following

3. Before conducting the experiment, we ensured that the models acted similarly in the direct and downward gaze videos. We covered the eyes of the models with a black rectangle, and asked raters, blind to the purpose of the study, to rate a few characteristics of the model on a 1–5 scale. Only one video was rated by each person. The videos of the male model were rated by 102 raters, and the videos of the female model by 43 raters. Between-subject *t*-tests found no statistically significant differences between ratings of direct and downward gaze videos. For comparisons of each individual characteristic, the *p*-values were as follows: friendly: p_{male} = .279, p_{female} = .896; approachable: p_{male} = .495, p_{female} = .826; threatening: p_{male} = .610, p_{female} = .603; attractive: p_{male} = .539, p_{female} = .209; happy: p_{male} = .551, p_{female} = .056; inspiring: p_{male} = .169, p_{female} = .685; angry: p_{male} = .877, p_{female} = .106; dominating: p_{male} = .746, p_{female} = .244; trustworthy: p_{male} = .226, p_{female} = .305; scary: p_{male} = .540, p_{female} = .305; fluent in speech: p_{male} = .167, p_{female} = .336; convincing: p_{male} = .966, p_{female} = .351; understandable: p_{male} = .076, p_{female} = .382.

reflective stage questionnaire in a neutral tone. The videos were between 25–28 seconds in length.

Procedure. Participants arrived in the laboratory in groups of three. The experimenter was blind to the condition of each participant. The same mental visualization cover story was used as in Experiment 1. After instructions and the first video, participants played Cyberball. The manipulation was otherwise identical to Experiment 1, except the game included three characters instead of four, and the game lasted for 30 throws in total. Participants in the inclusion condition received approximately 33% of the throws, and participants in the exclusion condition received it once from each character in the beginning of the game.

The reflexive stage measurements were administered identically to Experiment 1 ($\alpha_{\text{basic needs}} = .98$). After the questionnaire, participants were shown one of the eye gaze videos, described above. This was followed by the reflective stage measurement. The basic need ($\alpha = .91$), mood, and pain measurements were identical to Experiment 1. Results for mood and pain measurements are presented in Supplementary Materials. As a manipulation check, participants assessed the percentage of the time the model was looking at them. We also probed participants' suspicion,[4] asked them to complete a self-awareness questionnaire, and to rate a few characteristics of the model. Details and results of these measurements are presented in Supplementary Materials. Finally, participants were thoroughly debriefed.

RESULTS AND DISCUSSION

Manipulation Checks. After the reflexive stage measurements, excluded participants reported receiving less of the total number of tosses ($M = 10.1\%$, $SD = 8.6$) than included participants ($M = 31.8\%$, $SD = 7.4$), $t(79) = 12.08$, $p < .001$, $d = 2.70$, 95% CI [18.14, 25.29], in the Cyberball game. Compared to included participants, excluded participants also indicated being more ignored ($M_{\text{excluded}} = 4.30$, $SD_{\text{excluded}} = 0.89$, $M_{\text{included}} = 1.58$, $SD_{\text{included}} = 0.83$), $t(79) = 14.24$, $p < .001$, $d = 3.17$, 95% CI [-3.10, -2.34], and excluded ($M_{\text{excluded}} = 4.35$, $SD_{\text{excluded}} = 0.97$, $M_{\text{included}} = 1.40$, $SD_{\text{included}} = 0.64$), $t(79) = 15.92$, $p < .001$, $d = 3.60$, 95% CI [-3.32, -2.59]. After the reflective stage measurements, participants in the direct gaze group reported that the model was portraying more direct gaze ($M = 86.6\%$, $SD = 19.4$) than participants in the downward gaze group ($M = 29.5\%$, $SD = 28.9$), Welch's $t(68.0) = 10.40$, $p < .001$, $d = 2.32$, 95% CI [46.09, 67.98].

Basic Need Satisfaction. For basic need scores in each experimental group, see Table 2. A three-way mixed design ANOVA revealed a main effect of Inclusionary Status on basic need scores, $F(1, 77) = 104.40$, $p < .001$, $\eta^2_p = .58$, 95% CI [0.90, 1.34]. Excluded participants reported lower basic need satisfaction ($M = 2.72$, $SD = 0.50$)

4. We measured participants' suspicions concerning the Cyberball manipulation with a funnel-type questionnaire with open-ended questions. Although we did find that many participants, especially in the exclusion group, were suspicious, we did not find evidence that the level of suspicion was correlated with self-reported basic need satisfaction in either the reflexive or the reflective stage. Thus, we found no evidence that suspicion buffered against feelings of exclusion, or that demand characteristics drove the effect of the exclusion manipulation. Therefore, we did not exclude suspicious participants from the analyses. See supplementary materials for details and results of these measurements.

than included participants (M = 3.85, SD = 0.49). A main effect of Recovery Stage was also found, $F(1, 77) = 99.21$, $p < .001$, $\eta^2_p = .56$, 95% CI [-0.99, -0.52]. Basic need satisfaction was higher in the reflective stage (M = 3.63, SD = 0.60) than in the reflexive stage (M = 2.87, SD = 1.15), indicating recovery between the measurements. The main effect of Gaze Direction was not significant, $F(1, 77) = 2.21$, $p = .141$, $\eta^2_p = .03$, 95% CI [-0.14, 0.53].

The main effects were qualified by an Inclusionary Status × Recovery Stage interaction, $F(1, 77) = 143.34$, $p < .001$, $\eta^2_p = .65$. Immediately after the exclusion manipulation, in the reflexive stage, excluded participants reported lower basic need satisfaction than included participants, $t(79) = 15.06$, $p < .001$, $d = 3.37$, 95% CI [1.70, 2.22], showing that they felt excluded as expected. Excluded participants reported higher basic need satisfaction in the delayed, reflective stage than in the reflexive stage, $t(42) = 13.93$, $p < .001$, $d = 2.48$, 95% CI [-1.77, -1.32], indicating significant recovery, consistent with the temporal need-threat model of ostracism (e.g., Williams, 2007). Included participants' basic need satisfaction was marginally lower in the reflective stage, compared to the immediate, reflexive stage, $t(37) = 1.76$, $p = .087$, $d = 0.26$, 95% CI [-0.02, 0.30]. In the delayed, reflective stage, excluded participants reported lower basic need satisfaction than included participants, $t(79) = 2.17$, $p = .033$, $d = 0.50$, 95% CI [0.02, 0.54], indicating that, in this experiment, excluded participants had not completely recovered by the second measurement. This suggests that, unlike in Experiment 1, the delay between measurements did not allow for complete recovery of basic needs among excluded participants. There were no other interactions (largest F was for Inclusionary Status × Gaze Direction interaction, $F(1, 77) = 1.97$, $p = .164$, $\eta^2_p = .03$). Most importantly, the Inclusionary Status × Gaze Direction × Recovery Stage interaction was not significant, $F(1, 77) = 0.26$, $p = .614$, $\eta^2_p = .00$. Comparison of basic need scores of excluded participants in the direct and downward gaze groups in the delayed, reflective stage clearly demonstrates that the gaze directions did not differently moderate recovery from exclusion, Welch's $t(31.9) = 0.01$, $p = .992$, $d = 0.00$, 95% CI [-0.41, 0.41].

We designed the second experiment to address the possibility that the complete recovery of excluded participants in the first experiment was due to a distracting eye gaze manipulation. In the first experiment, excluded participants reported thwarted basic need satisfaction in the immediate, reflexive stage, but did not differ from the inclusion group in the reflective stage, possibly because the eye gaze manipulation with a mental visualization task distracted them. In Experiment 2, we administered the eye gaze stimuli in a way that was less distracting than in the first experiment, and would not allow for complete recovery of the effects of social exclusion. We succeeded in this goal, as excluded participants still reported lower basic need satisfaction than included participants in the reflective stage.[5] However, excluded participants shown videos with different gaze directions re-

5. It is also possible that the different outcome between the experiments was not due to different eye gaze manipulations, but rather because the delay between reflexive and reflective stage measurements was not identical. Excluded participants may have recovered less in Experiment 2 than in Experiment 1, simply because less time passed between the exclusion manipulation and the reflective stage questionnaire.

TABLE 2. Basic Need Scores For Each Experimental Group In Both Recovery Stages (Experiment 2)

	Direct gaze *M* (*SD*)	Downward gaze *M* (*SD*)	Overall mean *M* (*SD*)
Reflexive stage			
Included	4.04 (0.53)	3.78 (0.61)	3.92 (0.57)
Excluded	1.96 (0.66)	1.94 (0.54)	1.95 (0.60)
Overall mean	2.97 (1.21)	2.77 (1.09)	2.87 (1.15)
Reflective stage			
Included	3.96 (0.40)	3.58 (0.57)	3.78 (0.51)
Excluded	3.50 (0.80)	3.49 (0.47)	3.49 (0.64)
Overall mean	3.72 (0.67)	3.53 (0.51)	3.63 (0.60)

Note. The measurements were made on a 1 (not at all) to 5 (extremely) scale

ported similar levels of basic need satisfaction in the reflective stage, suggesting that direct eye gaze did not facilitate recovery of affective distress after exclusion.

META-ANALYSES

In two experiments, we did not find evidence that seeing direct gaze could facilitate basic need recovery after social exclusion. However, the true effect may be weaker than we had anticipated, and thus our experiments may have lacked statistical power to detect it. Following the suggestion by Cumming (2014), we conducted a meta-analysis of our two experiments to estimate confidence intervals for the effect size. The analysis was conducted using Comprehensive Meta-Analysis software. We were interested in the standardized mean difference (Cohen's *d*) between excluded participants in the direct and downward gaze groups. The effect size for both experiments was calculated using means and standard deviations of reflexive and reflective stage basic need scores (i.e., pre- and post-scores, respectively) in the two groups, and the correlation between these scores (Borenstein, Hedges, Higgins, & Rothstein, 2009). A random effects model suggested an effect size of $d = 0.08$, $p = .724$, 95% CI [-0.36, 0.52]. Thus, we found no evidence that seeing direct gaze, compared to seeing downward gaze, moderates recovery of basic needs after exclusion. However, this possibility cannot be conclusively ruled out, either, as the confidence interval for the effect of gaze on basic need recovery includes relatively large effect sizes.

We originally suggested that excluded individuals may seek direct gaze as a coping strategy that can make them feel reconnected. If this is the case, it would seem likely that the effect of direct gaze on basic need recovery would be no smaller than that of simple, low-effort coping strategies such as distraction. A search of the literature revealed that a few studies have found that directing attention away from exclusion by distraction (Wesselmann et al., 2013), self-affirmation, prayer (Hales et al., 2016), or focused attention (Molet et al., 2013), facilitates recovery of basic needs after social exclusion. These studies have used very similar experimental designs and dependent variables as our experiments. We subjected these studies to a small-scale meta-analysis to find if the effect of these manipulations was different from that of seeing direct gaze. We used the same analytic strategy as in the analysis of the results of our own experiments. All manipulations were pooled into one group, and this group was compared to the control group in which participants' attention was not directed away from exclusion. Study 2 by Hales and colleagues (2016) was excluded because there was no control group. When the correlation between pre- and post-scores was not available, the effect size was calculated using the mean basic need scores in the reflexive and reflective stages and the F-statistic of the respective interaction. The meta-analysis suggested a large effect size of $d = 0.85$, $p < .001$, 95% CI [0.61, 1.10], showing that directing attention to another task is highly effective in facilitating basic need recovery. Remarkably, the confidence intervals of our two meta-analyses do not overlap (see Figure 1 for forest plots). This clearly shows that, even if seeing direct gaze would have some effect on basic need recovery after exclusion, this effect is smaller than that of directing attention to another task.

GENERAL DISCUSSION

The main aim of the current study was to investigate if receiving direct gaze alleviates affective distress caused by social exclusion. In two experiments, participants excluded in Cyberball, compared to included participants, reported lower basic need satisfaction immediately after the manipulation, consistent with previous research (Hartgerink et al., 2015). In the first experiment, both excluded and included participants reported similar levels of basic need satisfaction in the delayed measurement, suggesting that excluded participants had recovered completely. This was possibly due to distraction caused by the eye gaze video and the concurrent mental visualization task. In our second experiment, we used an eye gaze manipulation that was designed to be less distracting than the one used in the first experiment. Excluded participants recovered significantly, but not completely by the delayed, reflective stage, offering support for Williams's temporal need-threat model (e.g., Williams, 2007). Importantly, our main hypothesis was not supported, as the eye gaze manipulation did not moderate recovery of basic needs among excluded participants in either experiment.

It was surprising that seeing direct gaze did not alleviate the effects of exclusion in the present study, as previous research has demonstrated that even minimal acknowledgment can facilitate recovery after exclusion (Rudert et al., 2017). However, there is one important distinction between the current study and previous research examining how acknowledgment or inclusion moderates the effects of exclusion (Gross, 2009; Rudert et al., 2017; Twenge et al., 2007; Zwolinski, 2014). In the previous studies, participants either interacted with other people, or believed that they did. In our experiments, participants were shown a cue of acknowledgment, but participants were well aware that they were not in a genuine eye contact with another person. A growing body of evidence shows that live faces and pictures of faces do not always elicit similar physiological, behavioral, and experien-

Meta-analysis 1

	d	95% CI
Experiment 1	0.15	[-0.50, 0.81]
Experiment 2	0.02	[-0.58, 0.62]
Random effects model	0.08	[-0.36, 0.52]

Meta-analysis 2

	d	95% CI
Wesselmann et al., 2013	0.71	[0.10, 1.31]
Hales et al., 2016, Exp. 1	1.00	[0.55, 1.45]
Hales et al., 2016, Exp 3	0.75	[0.39, 1.11]
Molet et al., 2013	1.21	[0.34, 2.08]
Random effects model	0.85	[0.61, 1.10]

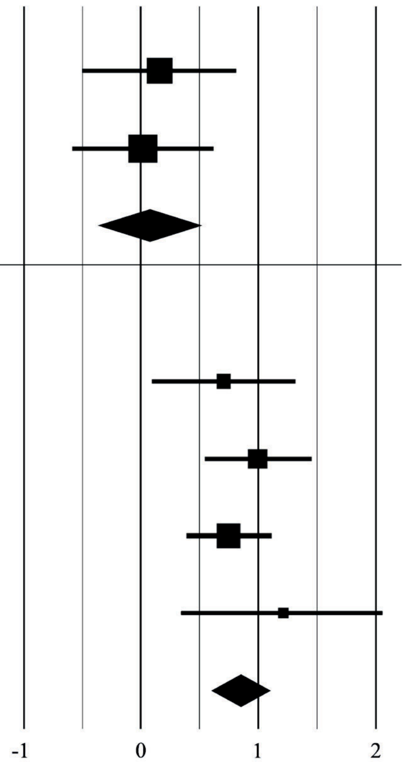

FIGURE 1. Effect sizes suggested by the two meta-analyses. The analyses examined the effectiveness of seeing direct gaze (Meta-analysis 1), and directing attention away from exclusion (Meta-analysis 2) at facilitating recovery of basic needs after exclusion in Cyberball. Sizes of the squares represent the proportional weight of the study in the meta-analysis. The different manipulations in the experiments by Hales et al. (2016) were combined into one group for the purposes of this analysis.

tial responses in the observer (see e.g., Hietanen et al., 2008; Hietanen & Hietanen, 2017; Pönkänen, Alhoniemi, Leppänen, & Hietanen, 2011; Risko, Richardson, & Kingstone, 2016), possibly because the person is aware that a pictorial face does not actually look back (see Myllyneva & Hietanen, 2015). Seeing visual cues of acknowledgment may not be sufficient to alleviate the effects of exclusion if the cues do not genuinely indicate that one is being attended to by another individual. Future research could examine if seeing direct gaze portrayed by a live person would facilitate recovery from exclusion, even if direct gaze by a pictorial face does not.

While a picture of another person cannot be a source of genuine acknowledgment, these stimuli still seem to be of particular significance for excluded individuals. A number of studies show that excluded participants, compared to controls, tend to allocate more attention to pictures of faces showing positive facial expressions (Buckner, DeWall, Schmidt, & Maner, 2010; DeWall et al., 2009; Tanaka & Ikegami, 2015; Xu et al., 2015; but see Tuscherer et al., 2015). Not only do excluded individuals tend to look at pictures of smiling faces, but they may also fixate more on the eyes than included participants (Böckler et al., 2014), and be more likely to consider that pictures are portraying direct gaze (Lyyra et al., 2017). We originally proposed that this tendency to seek direct gaze would be a coping strategy that could make excluded individuals feel reconnected. However, the current study suggests that seeing a face portraying direct gaze is not sufficient to moderate recovery from exclusion. Our results show that merely focusing attention to another task has more effect on recovery of basic needs than perceiving direct gaze. Perhaps excluded individuals seek direct gaze, not to regulate their own affective state, but to obtain information about potential for social interaction. Receiving direct gaze might increase affiliative behavior, and help the excluded individual attain reinclusion, even though the perception of this cue, as such, has little or no effect on basic need recovery.

While people often respond to exclusion by trying to reaffiliate, they can also sometimes aggress or withdraw from interactions (see Smart Richman & Leary, 2009). A tendency to seek eye contact may be related to the affiliation motivation, but other motivational responses to exclusion might be associated with different types of gaze behavior. As well as affiliative tendencies, displays of aggression tend to be accompanied with direct gaze (see Kleinke, 1986), and therefore an aggressive response to exclusion may also be associated with increased fixations to the eye region. However, when individuals respond to exclusion by seeking solitude (Ren, Wesselmann, & Williams, 2016), they might avoid eye contact. These hypotheses could be examined in future studies.

LIMITATIONS

One limitation of our experiments is the lack of a non-social control condition in the eye gaze manipulation. We cannot determine if the video viewing task as such had an effect on participants' basic need satisfaction, regardless of the model's gaze direction. All participants were shown a video of a person, and in Experiment 1, they imagined an interaction with the individual. Because of the quasi-social nature of this task, it may have been a mildly exclusionary or inclusionary experience, and could have influenced participants' affect more than a comparable non-social task or passing of time would have.

CONCLUSION

Previous research has suggested that excluded individuals seek eye contact, presumably because direct gaze signals inclusion. We hypothesized that receiving direct gaze would alleviate affective distress caused by exclusion. However, this hypothesis was not supported. In two experiments, receiving direct gaze had no effect on recovery of basic needs after social exclusion. Perhaps excluded individuals seek direct gaze, not because it makes them feel reconnected as such, but as a means to an end—to facilitate reconnection.

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PUBLICATION
II

I don't need your attention: ostracism can narrow the cone of gaze

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I don’t need your attention: Ostracism can narrow the cone of gaze

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Abstract

Previous research has shown that ostracized participants seek inclusive cues, such as gaze directed at them, when trying to reaffiliate. However, instead of seeking reinclusion, ostracized individuals may sometimes withdraw from interactions if not offered an opportunity for reaffiliation. In the current study, after an ostracism manipulation with no reaffiliation opportunity, participants judged whether faces portraying direct gaze or slightly averted gaze (2° to 8° to the left and to the right) were looking at them or not. Compared to an inclusion group and a non-social control group, ostracized participants accepted a smaller range of gaze directions as being directed at them, i.e., they had a narrower “cone of gaze”. The width of the gaze cone was equally wide in the inclusion and control groups. We propose that, without an opportunity for reaffiliation, ostracized participants may start to view other people as particularly unapproachable, possibly indicative of a motivational tendency to disengage from interactions.

Introduction

Eye gaze has a pivotal role in human communication. It is used, among other things, to express intimacy, regulate interactions, and exercise social control (see Kleinke, 1986). An especially salient cue is direct gaze (i.e., another individual's gaze directed at the perceiver). Direct gaze communicates that another's attention is directed to the self (see Conty, George, & Hietanen, 2016).

Being looked at shifts attention to the looker (Böckler, van der Wel, & Welsh, 2014), increases autonomic arousal (Helminen, Kaasinen, & Hietanen, 2011), and automatically elicits positive affective reactions (Chen, Helminen, & Hietanen, 2017). Seeing someone portray direct or averted gaze also elicits brain responses indicative of a tendency to approach or avoid, respectively (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008). Thus, humans may be likely to approach individuals portraying direct gaze, and to avoid individuals looking away.

Direct gaze may be especially significant for individuals who have been ostracized (i.e. ignored and excluded by others; Williams, 2007). In one study, participants who were excluded from an interaction, compared to included participants, fixated more on the eyes of their interaction partners, suggesting that they attempted to make eye contact to get back into the interaction (Böckler, Hömke, & Sebanz, 2014). Being denied others' direct gaze can engender feelings of ostracism: it lowers mood and satisfaction of four basic social needs of belonging, control, self-esteem, and meaningful existence (Wirth, Sacco, Hugenberg, & Williams, 2010). Indeed, gaze avoidance has been deemed the most common cue to indicate ostracism (Williams, Shore, & Grahe, 1998).

There is no clear cut-off point for when eye gaze is judged as direct or averted, but people interpret a range of gaze directions as direct (e.g., Gamer & Hecht, 2007; Stoyanova, Ewbank, & Calder, 2010). The width of this range, called "cone of gaze", is moderated by individual factors such as social anxiety (e.g., Chen, Nummenmaa, & Hietanen, 2017; Gamer, Hecht, Seippt, & Hiller, 2011; Schulze, Lobmaier, Arnold, & Renneberg, 2013) and visual properties of the target, such as facial expression (Ewbank, Jennings, & Calder, 2009; Lobmaier & Perrett, 2011, Harbort, Witthöft, Spiegel, Nick, & Hecht, 2013). A recent study suggested that being ostracized can widen the gaze cone (Lyyra, Wirth, & Hietanen, 2017). Participants were either ostracized or included in a virtual ball-tossing game, Cyberball (see Williams & Jarvis, 2006), after which they were asked to judge whether faces portraying varying gaze directions were looking at them or not. Ostracized participants accepted a wider range of gaze directions as being direct. It was suggested that ostracism caused widening of the gaze cone, which could help ostracized participants attain reinclusion. As direct gaze can signal social inclusion (Wesselmann, Cardoso, Slater, & Williams, 2012; Wirth, Sacco et al., 2010), the finding suggests that ostracized participants were biased to view others as portraying an affiliative cue.

The finding that ostracism widened the gaze cone contributed to a growing body of research reporting that ostracism can elicit cognitive biases that might foster affiliative behavior. As ostracism threatens the fundamental need for belonging, and can be detrimental to one’s wellbeing, ostracized individuals often strive for reinclusion (Smart Richman & Leary, 2009; Williams, 2007). Being socially included is an effective way of coping with ostracism (e.g. Zwolinski, 2014), and thus excluded individuals may act in an affiliative manner, such as conforming with a group’s opinions (Williams, Cheung, & Choi, 2000), and mimicking others’ nonverbal behavior (Lakin, Chartrand, & Arkin, 2008). Ostracized individuals may also show cognitive biases that help them attain reinclusion. For instance, exclusion, as compared to control manipulations, has been found to increase participants’ allocation of attention to positive social cues (DeWall, Maner, & Rouby, 2009; Xu et al., 2015) and cause them to judge other people as more friendly and attractive (Maner, DeWall, Baumeister, & Schaller, 2007), and to rate inanimate faces as more alive (Powers, Worsham, Freeman, Wheatley, & Heatherton, 2014).

However, sometimes ostracism can also evoke other motivational responses, such as increasing socially avoidant tendencies (Ren, Wesselmann, & Williams, 2016; Smart Richman & Leary, 2009). According to the multimotive model proposed by Smart Richman and Leary (2009), several situational and individual factors determine the motivational response to exclusion, but one important determinant is whether the individual perceives an opportunity for reaffiliation. When there is no such opportunity, the individual may withdraw and seek solitude (for similar suggestions, see also Cuadrado, Tabernero, & Steinel, 2015; Romero-Canyas et al., 2010), and start to view other people as portraying less affiliative cues (Smart Richman, Martin, & Guadagno, 2016). While theoretical models have described the factors that moderate the effects of ostracism, few studies have empirically investigated the conditions under which ostracism elicits these different social cognitive biases (for some exceptions, see Maner et al., 2007; Tanaka & Ikegami, 2015; Tuscherer et al., 2015).

As widening of the gaze cone may have reflected the affiliative response to exclusion (Lyyra et al., 2017), it might only occur when excluded participants perceive an opportunity for reaffiliation. In this earlier study, participants played a ball-tossing game ostensibly with others located in the same room. Thus, after the game, ostracized participants could attempt to reaffiliate with the alleged sources of the ostracism. Given the diverse, multifaceted responses to ostracism, it is important to investigate how situational factors moderate the effects of ostracism on gaze judgments. In a context where reaffiliation with the ostracizers or others is not possible, ostracism could narrow rather than widen the gaze cone. To examine this hypothesis, we conducted the present study, in which we measured participants’ gaze cone after the Cyberball ostracism manipulation. However, unlike in the previous study (Lyyra et al., 2017), participants were led to believe the game was played online with other participants located in other laboratories. Thus, social interaction was limited to the ball-tossing game, and reaffiliation would not be possible for the ostracized participants.

A second important goal of this study was to investigate if the effects of the Cyberball manipulation on the width of the gaze cone, as well as on affect, are indeed driven by ostracism as proposed in earlier studies, or if social inclusion also has an effect. One limitation of most earlier studies using this manipulation is that they lack a non-social control condition (for exceptions, see Driscoll, Barclay, & Fenske, 2017; Riva, Williams, Torstrick, & Montali, 2014). Excluded participants are typically compared to included participants, and differences between these two groups are interpreted to reflect effects of ostracism. However, without a control group it is impossible to verify whether the observed differences are due to exclusion, inclusion, or both. Engaging in social interactions (McIntyre, Watson, Clark, & Cross, 1991), and receiving cues of inclusion, such as direct gaze (Chen, Helminen, & Hietanen, 2017) or a smile (Murphy & Zajonc, 1993) evoke positive affective responses, and thus social inclusion might not be a sufficient control condition when investigating the effects of ostracism. Indeed, meta-analytic evidence suggests that some of the effects observed in exclusion studies may be partly driven by inclusion, as studies comparing socially excluded participants to accepted participants report larger effects on mood than similar studies with neutral control groups (Blackhart, Nelson, Knowles, & Baumeister, 2009). To rule out the possibility that the effects of the Cyberball manipulation on the gaze cone (Lyyra et al., 2017), mood, satisfaction of basic social needs (Williams, 2007), and social pain (Eisenberger & Lieberman, 2004) are driven by inclusion, we included a non-social control group in the current study. In this group, participants played a variant of Cyberball with no social interaction.

In the present study, after the Cyberball ostracism manipulation, participants filled a short questionnaire measuring satisfaction of basic social needs, mood, and social pain. After this, participants judged whether faces portraying direct gaze and subtle deviations from direct gaze were looking at them or not. We hypothesized that ostracized participants, compared to the inclusion and control groups, would have a narrower gaze cone, i.e., they would judge a smaller range of gaze directions as being direct. Alternatively, if situational factors do not modulate the effect of ostracism on evaluations made of others’ gaze directions, ostracism should lead to widening of the gaze cone like in a previous study by Lyyra et al. (2017), and ostracized participants would have a wider gaze cone than the inclusion and control groups. We expected to find no differences in the width of the gaze cone between the inclusion and control groups. These results would indicate that it is ostracism, and not inclusion, that influences the width of the gaze cone. As for the questionnaire data, we hypothesized that ostracized participants would report lower basic need satisfaction and mood, and more social pain than participants in the inclusion and control groups, while the inclusion and control groups would not differ from each other on any of these measurements.

Method

Participants. Participants were 81 volunteers (19 males, M_{age} = 25.9 years, SD_{age} = 7.7) with no diagnosed psychiatric or neurological disorders. Participants were randomly assigned in one of three groups: inclusion, exclusion, or control. We did not conduct a priori power analyses, but the aim was to get approximately 20 participants per condition in the final sample (as in Lyyra et al., 2017; the minimum sample size recommended by Simmons, Nelson, & Simonsohn, 2011; see the Data analysis section for details of the final sample). During data collection, it became apparent that a large number of participants in the exclusion group would have to be excluded from the analyses due to suspicion (see the Data analysis section, for exclusion criteria). Thus, we adjusted the number of participants assigned to each group to ensure an even distribution of participants in each group in the final sample. Participants were rewarded with either partial course credit or a movie ticket. All participants signed a form of informed consent. An ethical statement for the study was obtained from Ethics Committee of the Tampere Region.

Stimuli and apparatus. Stimuli were presented on a 19" LCD monitor with a resolution of 1280 × 1024 and a refresh rate of 60 Hz. Participants' viewing distance from the monitor was fixed at 63 cm using chin and forehead rests, with participants' eye area vertically and horizontally leveled with that of the stimulus characters'. E-Prime® 2.0 software was used to control the stimulus presentation and to acquire data. The Cyberball game was presented on Firefox 17.0.5. Internet browser.

For the ostracism manipulation, three different versions of Cyberball 4.0 (Williams & Jarvis, 2006) were employed. In the inclusion and exclusion conditions, three characters, one controlled by the participant and the others controlled by the computer, were throwing a ball with each other. In the inclusion condition, the participant received approximately one-third of all tosses. In the exclusion condition, the participant received the ball once from each character at the beginning of the game, and then never again. The total number of tosses in the game was 30. In the control condition, the two other characters were replaced by pictures of baskets, in which the participants were throwing the ball (see Fig. 1). After each throw, the ball returned to the participant's character. The total number of throws was reduced, so that participants in the inclusion and control conditions made the same number of throws. The pace of the game was adjusted so that the game length was similar across conditions.

Fig. 1 Illustration of the control condition in Cyberball.

For the gaze cone task, we used pictures of four virtual characters with frontal head orientation (two males, two females) created with 3D animation software DAZ Studio. Pictures were chosen from the set used by Lyyra et al. (2017). In the pictures, each character portrayed nine different gaze directions: 0° (direct gaze), 2°, 4°, 6° and 8° (averted towards left and right). In addition, each picture was flipped horizontally to account for any effect caused by face asymmetry. The characters had a mildly friendly expression to avoid a sullen, negative face, which together with direct gaze might signal exclusion rather than inclusion (e.g., Adams & Kleck, 2005). The sizes of the characters were approximately 10° vertically and 8° horizontally.

Procedure. Participants arrived in the laboratory alone. They were told the aim of the experiment was to study "mental visualization". To enhance the cover story, participants filled a questionnaire ostensibly measuring their tendency to mentally visualize. Participants were told they would be playing a ball tossing game on a computer, and were instructed to mentally visualize the game in detail. Participants in the inclusion and exclusion groups were told the game was played online with two other participants based in other laboratories. To ensure the experiment was as similar as possible across conditions, participants in the control condition were told that the experiment was conducted simultaneously in three laboratories. To increase plausibility of the cover story, the experimenter made a fake video call, in which he and two other experimenters made sure everything was ready in each laboratory. This was immediately followed by the Cyberball manipulation.

Basic need, mood, and pain measurements. After Cyberball, participants completed a short, six-item questionnaire measuring satisfaction of basic social needs of belonging ("I felt rejected"), control ("I felt I had the ability to significantly alter events"), meaningful existence ("I felt important"), and self-esteem ("I felt insecure"), as well as both positive mood ("I felt happy") and negative mood ("I felt angry"). The items were chosen from a basic need questionnaire used in several ostracism studies (e.g. Molet, Macquet, Lefebvre, & Williams, 2013; Wirth &

Williams, 2009). Only one item measuring each basic need and both positive and negative mood was chosen to ensure the interval between the ostracism manipulation and the gaze cone task was as short as possible. Also, many of the items in the basic need questionnaire were not suitable for the non-social control condition. The basic need items were reverse scored where necessary, and averaged to create an index of basic need satisfaction (α = .79). Participants were also asked how much pain they were experiencing during the game. Additionally, two manipulation check items were presented: participants were asked to assess what percentage of throws in the game was made by them, and asked to what extent they felt excluded or included in a group. All items were on a visual analogue scale, scored 0-100.

Gaze cone task. After the questionnaire, participants completed the gaze cone task. In each trial, a fixation cross was displayed for 800 ms, after which a stimulus face was shown for 150 ms (see Fig. 2). After the stimulus face, participants were presented with two consecutive response windows (R1 and R2). In the first response window (R1), participants were asked whether they felt the person in the picture was looking at him/her or not. The response was given using numbers on the keyboard (1 = yes, 2 = no). In the second response window (R2), participants were asked to evaluate the strength of the feeling on a 3-point scale (1 = strong, 2 = intermediate, 3 = weak). If the participant did not respond within seven seconds, the next item (either the next response window or the next trial) was displayed.

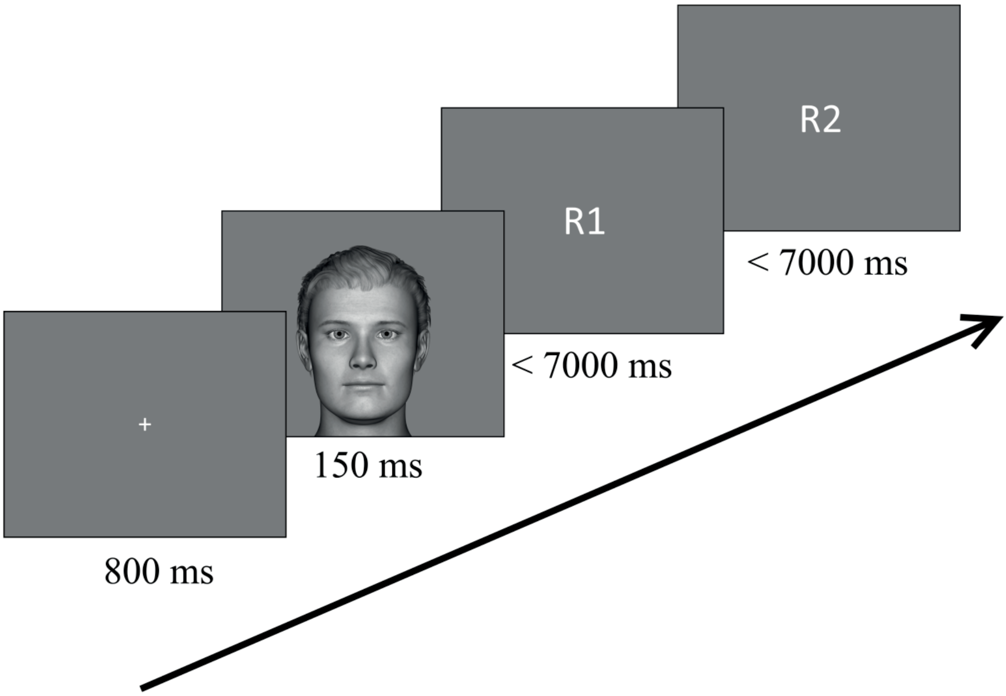

Fig. 2 Illustration of a single trial in the gaze cone task. R1 and R2 stands for response windows 1 and 2. In R1, participants indicated whether they felt the person in the picture was looking at him/her or not. In R2, participants indicated the strength of the feeling on a 3-point scale (strong, intermediate, weak).

Two blocks of trials were completed by the participants. In each block, each gaze direction (including horizontally flipped pictures) of two randomly chosen characters (one male, one female) were presented in a random order. In the second block, the pictures of the other two characters were presented. This resulted in a total of 72 trials (8 per gaze direction), with 36 trials per block. In between the blocks, participants were allowed to rest and were reminded of the instructions. The length of the pause between the blocks was determined by the participants themselves. The number of trials was chosen based on a previous finding that the effect of an ostracism manipulation on the gaze cone dissipated in the latter half of a 144-trial task (Lyyra et al., 2017). Some other previous studies using a similar task also used a comparable number of trials (Chen, Nummenmaa, & Hietanen, 2017).

Debriefing. At the end of the experiment, participants' suspicions concerning the Cyberball task were checked with an interview. After this, participants were thoroughly debriefed. They were told the purpose of the study and explained the deceit concerning the Cyberball task.

Data analysis. We analyzed the width of the gaze cone for each participant by calculating the point of subjective equality (PSE), the point where the perceiver cannot distinguish between two different stimuli. The two blocks in the gaze cone task were combined into one for the purposes of this analysis, as there were not enough trials to reliably calculate the PSE for the blocks separately. First, we calculated a binary logistic regression model for each participant based on their answers on the first response window (R1; see Lyyra et al., 2017). Following previous research (e.g. Lobmaier & Perrett, 2011; Lyyra et al., 2017; Uono & Hietanen, 2015), we collapsed the trials with gaze averted to the left and the right, resulting in five different gaze directions (0°, 2°, 4°, 6°, 8°). The trials on which participants did not reply within seven seconds (0.6% in R1) were removed from the data before the analyses. We calculated the PSE from the regression model by solving for the gaze deviation degree, which the participant was equally likely to consider as direct or averted gaze. The distance from zero degrees to the PSE, multiplied by two to cover both left and right sides, was used as an approximation of the width of the gaze cone (see Ewbank et al., 2009).

Gaze cone widths, as well as basic need, mood, and pain items were subjected to one-way ANOVAs with inclusionary status (included, excluded, control) as the independent variable. Post-hoc tests were conducted using Tukey's HSD test. In case of unequal variances between groups, the analyses were conducted using Welch's robust test of equality of means, and Games-Howell post-hoc tests. For the sake of clarity, uncorrected degrees of freedom are presented with Welch's test. Analyses of negative mood and pain items were conducted using Box-Cox transformed scores to correct for non-normal distribution of the data. Untransformed means and standard deviations are presented.

From the total sample of 81 participants, we excluded 14 participants before further analyses. First, nine participants (one in the inclusion condition, eight in the exclusion condition) were excluded because they indicated they did not believe they were playing the Cyberball game with other people[1]. Four more participants (one in the inclusion condition, two in the exclusion condition, and one in the control condition) were excluded because the width of their gaze cone could not be calculated because the number of 'direct' responses was more than 50% for each gaze direction (see Ewbank et al., 2009). Finally, we excluded one more participant (in the exclusion condition) as an outlier, as the width of the gaze cone was not within three standard deviations from the mean. The final sample consisted of 67 participants ($n_{\text{included}} = 22$, $n_{\text{excluded}} = 22$, $n_{\text{control}} = 23$, 16 males, $M_{\text{age}} = 25.6$ years, $SD_{\text{age}} = 7.7$).

RESULTS

Manipulation checks. Manipulation checks suggest that participants perceived the ostracism manipulation as intended. The groups differed in the percentage of all throws they recalled making (Welch's $F(2, 64) = 98.02$, $p < .001$, $\eta_p^2 = .72$). Participants in the control group indicated making a larger percentage of all throws (M = 80.1%, $SD = 27.0$) than participants in the inclusion (M = 38.8%, $SD = 12.0$; $t(64) = 6.69$, $p < .001$, $d = 1.98$) and exclusion groups (M = 13.0%, $SD = 5.8$; $t(64) = 11.66$, $p < .001$, $d = 3.44$). Included participants indicated making a larger percentage of throws than excluded participants ($t(64) = 9.06$, $p < .001$, $d = 2.73$). The groups also differed in how included or excluded they perceived being (Welch's $F(2, 64) = 40.41$, $p < .001$, $\eta_p^2 = .44$). Participants in the exclusion group indicated being more excluded ($M = 80.8$, $SD = 17.1$) than participants in the inclusion ($M = 28.9$, $SD = 21.8$; $t(64) = 8.78$, $p < .001$, $d = 2.65$) and control groups ($M = 44.3$, $SD = 32.7$; $t(64) = 4.72$, $p < .001$, $d = 1.40$). Participants in the control group did not indicate being more excluded than participants in the inclusion group ($t(64) = 2.08$, $p = .207$, $d = 0.56$).

The gaze cone. See Table 1 and Fig. 3 for means and standard deviations of gaze cone widths in the three experimental groups, as well as statistics for the one-way ANOVA and multiple comparisons. The results indicate that the ostracism manipulation had an effect on the width of the participants' gaze cone, as excluded participants had significantly narrower gaze cone than participants in the inclusion group, and marginally narrower gaze cone than participants in the control group. There was no difference in the width of the gaze cone between participants in the control group and the inclusion group[2].

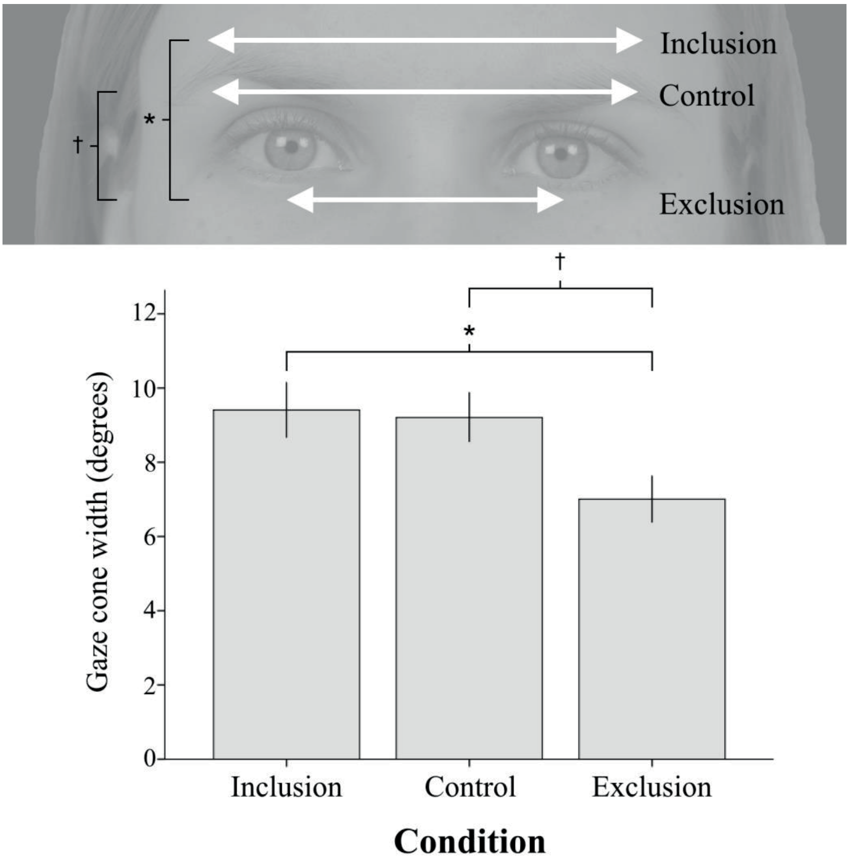

Fig. 3 Mean gaze cone widths in the three experimental groups. In the upper part of the figure, the gaze cone widths are projected on the perceiver’s eye region (observer’s interpupillary distance 64 mm). The width of the arrow indicates the range of laterally averted gaze directions, which the perceiver still considers as direct gaze. In the lower part of the figure, the error bars stand for standard error of the means.

Basic need satisfaction, mood, and pain. See Table 1 for means and standard deviations of basic need, mood and pain scores in each experimental group, as well as statistics for one-way ANOVAs and multiple comparisons. To summarize, these results indicate that excluded participants reported lower basic need satisfaction and lower positive mood than participants in the inclusion and control groups. Participants in the inclusion and control groups reported similar levels of basic need satisfaction and positive mood. In negative mood, we found a significant difference between the inclusion and the exclusion group. However, neither the inclusion nor the exclusion group differed significantly from the control group in negative mood. The ostracism manipulation had no effect on reported levels of pain.

Table 1. Gaze cone width, basic need, mood, and pain scores for each experimental group. Statistics for one-way ANOVAs and multiple comparisons.

				One-way ANOVA			Multiple comparisons					
	Included	Control	Excluded				Included-Excluded		Included-Control		Excluded-Control	
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	$F(2, 64)$	*p*	η_p^2	*p*	*d*	*p*	*d*	*p*	*d*
Gaze cone	9.4° (3.5)	9.2° (3.2)	7.0° (2.9)	3.87	.026	.11	.040	0.75	.979	0.06	.060	0.73
Basic needs	63.0 (16.4)	61.1 (19.8)	28.6 (16.2)	26.77	<.001	.46	<.001	2.11	.925	0.11	<.001	1.79
Pos. mood[u]	71.7 (15.8)	65.1 (30.2)	33.6 (19.2)	26.20	<.001	.36	<.001	2.17	.626	0.28	<.001	1.24
Neg. mood[u]	6.2 (13.8)	17.9 (24.3)	31.5 (26.1)	8.47	.001	.18	.001	1.21	.128	0.59	.182	0.54
Pain	4.6 (6.9)	7.4 (15.7)	9.8 (13.4)	0.95	.393	.03	.360	0.49	.731	0.24	.803	0.16

Notes: Basic need, mood, and pain measurements were on a 0-100 visual analogue scale; Multiple comparisons conducted using Tukey's HSD test; [u]Unequal variances between groups (tests conducted using Welch's robust test of equality of means, and Games-Howell post-hoc test)

Discussion

Gaze cone. In this study, we examined how ostracism influences the evaluations of others' gaze directions. We found that ostracized participants were more likely than participants in the inclusion and control groups to evaluate that faces were portraying averted gaze, i.e. they had a narrower gaze cone. Our results show that ostracism can have variable effects on the gaze cone, as ostracized participants showed widening of the gaze cone in a previous study using the same stimulus materials and experimental design as in the present study (Lyyra et al., 2017). The most significant difference between the current and the previous experiment was that, in the previous study, participants were ostensibly included or ostracized by others present in the laboratory, while in the current study, participants were in the laboratory alone, and were led to believe they were interacting with others online. Thus, participants in the present study could not reaffiliate with the ostracizers or new interaction partners. Our finding likely suggests that ostracism influences the gaze cone differently, depending on whether or not the ostracizers are physically present. The results of the current study contributes to an emerging body of evidence showing that exclusion can have variable effects on cognitive, evaluative, and perceptual processes, depending on situational factors (Bernstein, Sacco, Young, & Hugenberg, 2014; Smart Richman et al., 2016; Tuscherer et al., 2015).

Secondly, the present study showed that ostracism, but not inclusion, modulated the gaze cone, as there were no differences between participants in the inclusion and control groups. This is important, as previous research has not been able to conclusively determine whether the difference in the gaze cone between ostracized and included participants could be attributed to exclusion or inclusion (Lyyra et al., 2017). As presupposed in earlier research, the current study suggests that social inclusion is a suitable control condition when investigating how ostracism alters gaze direction judgments using the Cyberball ostracism manipulation. Similarly, we also found that inclusion did not influence participants' satisfaction of basic social needs or positive mood (see below for more detailed discussion). Of course, we cannot determine whether social inclusion is a suitable control condition when investigating other outcomes of ostracism, such as its effects on attention (e.g. Xu et al., 2015) or behavior (e.g. Kothgassner et al., 2017). While no study to date has shown that inclusion in Cyberball evokes cognitive, behavioral, or affective responses (see also Riva et al., 2014), this possibility cannot currently be disregarded, either. Social interactions influence affect (McIntyre et al., 1991), and inclusive cues such as direct gaze can have various affective, cognitive, and behavioral effects on the perceiver (Conty et al., 2016). Thus, to determine that an effect is driven by ostracism, future studies should compare ostracized participants to a non-social control group, in addition to a social inclusion group.

Narrowing of the gaze cone among excluded participants may be indicative of a socially avoidant motivational tendency, and individuals with narrowed gaze cone may be unlikely to engage in interactions. People tend to devalue their relationships with others who are avoiding eye contact, compared to those who are portraying direct gaze (Wirth, Sacco, et al., 2010), and seeing another person looking away has been shown to elicit brain responses related to avoidance motivation (Hietanen et al., 2008). While ostracized individuals may be highly motivated to satisfy their need for belonging (Williams, 2007), they sometimes respond by refraining from interactions (Ren et al., 2016). Individuals high in social avoidance motivation tend to interpret unclear pictures of faces as portraying angry facial expressions (Nikitin & Freund, 2015). Similarly, individuals who respond to ostracism by seeking solitude may start to view others as particularly unapproachable. It should be noted, however, that we did not directly measure participants' motivations or behavior, and thus more research is needed to show that narrowing and widening of the gaze cone are associated with avoidance- and approach-oriented motivational tendencies, respectively.

In the present study, we have suggested that widening of the gaze cone occurs when the ostracized participants have an opportunity for reaffiliation, and narrowing of the gaze cone occurs when they do not. According to the multimotive model, for ostracism to elicit prosocial responses, individuals need to perceive an opportunity to reaffiliate with either the sources of the exclusion or others (Smart Richman & Leary, 2009; see also Cuadrado et al., 2015; Romero-Canyas et al., 2010). When reaffiliation is not possible, the individual is likely to respond to exclusion by withdrawing from interactions, or with aggression (Smart Richman & Leary, 2009). In the present study, participants were unequivocally unable to reaffiliate with the ostensible ostracizers, as they were allegedly located in other laboratories, unlike in the previous study (Lyyra et al., 2017). We also believe that participants did not actually perceive the stimulus faces in the gaze cone task as potential interaction partners. While evaluations of their gaze directions were modulated by ostracism, it seems unlikely that these changes reflect the participants' willingness to affiliate with these stimulus characters in particular. A recent study found that receiving direct gaze from a picture of a face was not sufficient to make ostracized participants feel reconnected, possibly because pictures are not perceived as potential sources of reinclusion (Syrjämäki, Lyyra, Peltola, & Hietanen, 2017).

We stress that the current experiment does not allow us to definitively determine whether a possibility for reaffiliation is the critical factor that modulates the effects of ostracism on the gaze cone, as we did not manipulate it as a factor within the experiment. Meta-analytic evidence shows that the effects of exclusion on affect are different depending on whether participants are excluded by others present in the laboratory, or ostensibly located elsewhere (Blackhart et al., 2009). We conducted a second, small-scale experiment in which we tested if participants' experiences related to fulfillment of basic needs, desire for solitude, and hostility towards others, among other things, are also different depending on whether they are ostracized by others present in the laboratory, or located elsewhere, but the results were inconclusive[3]. We cannot verify or rule out the possibility that some other differences, besides the possibility for reaffiliation, could explain the opposing effects on the gaze cone in the present study and the previous study (Lyyra et al., 2017). For instance, the presence of other individuals could influence participants' self-awareness, which could hypothetically modulate the effects of ostracism. In conclusion, the current study shows that ostracism can cause narrowing of the gaze cone, but more research is needed to conclusively determine the conditions under which narrowing and widening of the gaze cone occur.

One intriguing question is whether changes in the width of the gaze cone are antecedents or consequences of the motivational response to ostracism. One possibility is that ostracism elicits perceptual biases (see e.g. Bernstein, Young, Brown, Sacco, & Claypool, 2008; Sacco, Wirth, Hugenberg, Chen, & Williams, 2011), which then influences the individual's motivational tendencies. If ostracized individuals perceive faces in an altered way, these effects could mediate the effects of ostracism on motivation, as perceiving faces as not signaling approach and affiliation might elicit socially avoidant motivational tendencies. Another possibility is that ostracism first evokes a motivational response, which then biases perceptual judgments accordingly. While we cannot determine causal relationships based on the present research, we believe the latter explanation better accounts for the effect of ostracism on the gaze cone. We suggest that biased judgments of gaze directions are a result, rather than a cause of a motivational response to ostracism. The motivational tendencies elicited by ostracism are more likely caused by a need to maintain satisfaction of basic social needs (Williams, 2007), as well as an individual's inferences of the ostracism episode and reaffiliation opportunities (Smart Richman & Leary, 2009). After responding motivationally, an individual then judges perceptions of gaze directions accordingly. We suggest that changes in the width of the gaze cone may influence an individual's behavior in social interactions, but they are not the cause of the general motivational tendency aroused by ostracism. Nevertheless, further studies are required to resolve the issue.

If narrowing of the gaze cone, and other evaluative, perceptual and cognitive biases, promote withdrawal after ostracism, they could have various short- and long-term consequences. These biases may be adaptive in the short term, as withdrawal can shield the ostracized individual from further hurt. However, they may also be detrimental, as suggested by Cacioppo and Hawkley's (2009) model of loneliness. They described a regulatory loop, in which lonely individuals show a hypervigilance towards negative social stimuli (see also Bangee, Harris, Bridges, Rotenberg, & Qualter, 2014; Qualter et al., 2013), which increases the likelihood of them engaging in behavior that further isolates them, and further reinforces these biases. Identifying the biases toward negative social stimuli that ostracism causes, and the boundary conditions for when they emerge, is important. It would allow researchers and clinicians to understand why and when ostracized individuals are at risk of entering the self-reinforcing regulatory loop, which can lead to chronic isolation and the respective physical and psychological problems (see Cacioppo & Hawkley, 2009). The current study, together with Lyyra et al.’s (2017) study, may suggest some of the boundary conditions for when ostracism can cause a bias toward exclusionary social stimuli. However, much more research is needed to understand the whole spectrum of cognitive and perceptual responses to ostracism, and the factors that influence them.

Basic needs, mood, and pain. In addition to the gaze cone, we measured participants’ basic need satisfaction, mood, and social pain with a questionnaire. A recent meta-analysis shows that participants ostracized in Cyberball consistently report lower basic need satisfaction than included participants (Hartgerink, van Beest, Wicherts, & Williams, 2015). Many studies have also found that ostracized participants report lower mood (e.g. Gross, 2009; Williams et al., 2000) and more pain (e.g. Wirth, Lynam, & Williams, 2010) than included participants. However, because these studies rarely use non-social control conditions (for exceptions, see Driscoll et al., 2017; Riva et al., 2014), it is possible that the observed effects are partly driven by inclusion. In our study, we compared ostracized and included participants to a control group. The results suggested that basic need satisfaction and positive mood was lowered by ostracism, and not improved by inclusion, as the inclusion group did not differ from the control group on these measurements. In negative mood, however, we only found a difference between included and ostracized participants. Neither of these groups differed significantly from the control group. It is possible that ostracism slightly increased negative mood, and inclusion slightly decreased it. Previous meta-analytic evidence shows that studies comparing rejected participants to accepted participants report larger effects on mood than studies using neutral control groups (Blackhart et al., 2009). Similarly, in studies using Cyberball, the effect size on negative mood may be slightly overestimated if the inclusion group is used as the sole control group.

We want to stress that these findings should be interpreted with caution. We used an abbreviated basic need and mood questionnaire to ensure a short interval between the ostracism manipulation and the gaze cone task. While we chose the items from a basic need questionnaire that has been found to have a very high intercorrelation among items (αs consistently exceed .90, see Molet et al., 2013; Syrjämäki et al., 2017; Wirth & Williams, 2009; Zadro, Boland, & Richardson, 2006), it should be noted that abbreviating the questionnaire lowers the validity and reliability of the measurements. Thus, our results may be more suggestive than conclusive. Nevertheless, we suggest that future studies could examine if inclusion, as well as exclusion in Cyberball influences participants’ affect.

Contrary to our hypothesis, we did not find an effect of the ostracism manipulation on reported levels of pain. A large number of previous studies using the Cyberball manipulation have found that ostracism causes pain (e.g. Bernstein & Claypool, 2012; Eisenberger, Lieberman, & Williams, 2003; Wirth, Lynam, & Williams, 2010). The null result is most likely due to type II error, and should therefore be interpreted with caution. However, future research could examine if there are factors that can render exclusion less painful. For instance, it was recently suggested that anticipated exclusion could be less painful than unexpected exclusion (Wesselmann, Wirth, & Bernstein, 2017).

Limitations. One limitation of the present study is that we had to exclude a large number of participants (17.3%) from the analyses. Most of them (64%) were excluded because they indicated that they believed the course of the Cyberball game was predetermined, or that they were not playing the game with other people. Only one participant in the inclusion condition expressed such suspicions, while a total of eight participants in the exclusion condition did so, suggesting that the exclusion condition was more likely to arouse suspicion. After including suspicious participants in the analyses, the differences between groups in the gaze cone remained in the same direction as before ($M_{\text{included}} = 9.3°$, $SD_{\text{included}} = 3.5$; $M_{\text{excluded}} = 7.8°$, $SD_{\text{excluded}} = 3.2$; $M_{\text{control}} = 9.2°$, $SD_{\text{control}} = 3.2$), but the effect size was diminished, and the difference did not reach statistical significance ($F(2, 72) = 1.66$, $p = .198$, $\eta_p^2 = 0.04$. It is possible that a selection bias may have skewed the final sample, so that the exclusion group differed from the other two groups, which could explain the effect of the Cyberball manipulation on the gaze cone. We attempted to find evidence for this by contacting the participants afterwards and asking them to complete the Social Phobia Scale (SPS; Mattick & Clarke, 1998), and Short Five (S5; Konstabel, Lönnqvist, Walkowitz, Konstabel, & Verkasalo, 2012), an inventory based on the Big Five model of personality. The response rate was 50.6%. However, we did not find differences in SPS or S5 scores between suspicious and non-suspicious participants (highest t was for conscientiousness; $M_{\text{suspicious}} = 2.00$, $SD_{\text{suspicious}} = 0.30$, $M_{\text{non-suspicious}} = 1.35$, $SD_{\text{non-sucpicious}} = 0.87$, $t(39) = 1.59$, $p = .120$, $d = 0.17$; all other ps > .40). When analyzing only participants included in the main analyses, we did not find differences between included, excluded and control participants in SPS or S5 scores either (highest F was for agreeableness, $F(2, 29) = 1.01$, $p = .378$, $\eta_p^2 = .07$; all other ps > .43). In conclusion, we could not find evidence of a selection bias skewing the final sample, although it is impossible to conclusively rule out this possibility.

Finally, it should be noted that although our control condition allowed us to infer that social exclusion, and not social inclusion, was driving the effect of the Cyberball manipulation on the gaze cone, it did not allow us to conclusively rule out all possible explanations as to what influenced the width of the gaze cone. For instance, we cannot rule out the possibility that narrowing of the gaze cone among excluded participants was a result of lowered mood (although, see Chen, Nummenmaa, & Hietanen, 2017, for evidence suggesting otherwise), expectancy violation (inherent to the exclusion condition of Cyberball, see Somerville, Heatherton, & Kelley, 2006), or other factors we did not control for.

Conclusion. The present study, together with earlier research (Lyyra et al., 2017), shows that situational factors determine how ostracism influences gaze direction judgments. This finding contributes to a growing body of research, which has found that various situational and individual factors can moderate the effects of ostracism on social cognition (e.g. Bernstein et al., 2014; Tanaka & Ikegami, 2015). Understanding the conditions under which ostracism elicits different cognitive biases is important, as these biases may predict how an individual will cope with social exclusion. The multimotive model (Smart Richman & Leary, 2009) appears to provide a useful framework for understanding when these different biases occur, although more empirical research on the issue is definitely still needed.

Notes

[1] Interestingly, it has been found that awareness that one is being ostracized by a computer program does not make the experience any less distressing (Zadro, Williams, & Richardson, 2004). However, it could moderate other outcomes of ostracism, such as its effects on motivation and behavior. For instance, a recent study found that ostracism decreased participants' prosocial behavior only when they were led to believe they were interacting with other human beings, rather than with a computer (Kothgassner et al., 2017). To ensure our results would not be influenced by participants' suspicions, we chose to exclude participants who indicated awareness of the deception in Cyberball. This decision was made before collecting the data.

[2] We also analyzed eye contact impression strength, combining data from both response windows (R1 and R2). The impression strengths were set in an ascending order (1 = not looking at me, strong impression, 2 = not looking at me, intermediate impression, 3 = not looking at me, weak impression, 4 = looking at me, weak impression, 5 = looking at me, intermediate impression, 6 = looking at me, strong impression). A Kruskal-Wallis test revealed that there were differences between the groups in the mean eye contact impression strength scores ($\chi^2(2) = 6.36$, $p = .042$). Mann-Whitney U-tests showed that excluded participants reported weaker eye contact impression strengths than participants in the inclusion group (mean ranks were 17.98 and 27.02, respectively, $U = 142.50$, $p = .019$), and the control group (mean ranks were 18.95 and 26.87, respectively, $U = 164.00$, $p = .043$). There were no differences between the inclusion and control groups (mean ranks were 23.14 and 22.87, respectively, $U = 250.00$, $p = .946$). These results expand on our main finding by showing that ostracized participants (compared to participants in inclusion and control

groups) not only considered a narrower range of gaze directions as being directed at them, but also reported weaker impressions of being looked at.

[3] In the small-scale experiment, we randomly allocated participants ($N = 42$) to be included or excluded in Cyberball (inclusionary status, between subjects factor), ostensibly played with other participants either present in the laboratory, or located elsewhere (experiment setting, between subjects factor). After the manipulation, participants completed basic need, mood and pain questionnaires, as well as the Need to Belong Scale (Leary, Kelly, Cottrell, & Schreindorfer, 2013), Solitude-seeking Scale (Ren et al., 2016), and State Hostility Scale (Anderson, Deuser, & DeNeve, 1995). We did not find evidence that ostracized participants in the two different settings responded differently on these scales. Two-way between-subject ANOVAs found an expected effect of inclusionary status on basic needs, mood, and pain (all ps < .001), but no effect of experiment setting (all ps > .1), or an interaction between the two factors (all ps > .1). On the other scales, which were more crucial for our research question, we found no main effects (all ps > .1) or interactions (all ps > .4). We chose not to proceed further with this research, as the scales did not appear to be very sensitive to our manipulations, and a very large sample size would likely be needed to detect interactions, and this was outside the scope of the current study.

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Compliance with ethical standards

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Conflict of interest. The authors declare no conflict of interest.

Ethical approval. All procedures in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of the Tampere Region, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent. Informed consent was obtained from all participants included in the studies.

Data availability. The datasets analysed during the current study are not publicly available to not compromise participant consent, but are available from the corresponding author on reasonable request.

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PUBLICATION
III

Social inclusion, but not exclusion, delays attentional disengagement from direct gaze

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ORIGINAL ARTICLE

Social inclusion, but not exclusion, delays attentional disengagement from direct gaze

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Abstract

The present study investigated whether another person's direct gaze holds a perceiver's visuospatial attention and whether social exclusion or social inclusion would enhance this effect. Participants were socially excluded, socially included, or underwent a non-social control manipulation in a virtual ball-tossing game. The manipulation was followed by an attentional disengagement task, in which we measured manual response times in identification of peripheral stimuli shown to the left or right of centrally presented faces portraying direct or downward gaze. Contrary to our hypotheses, the response times were not, in general, longer for direct gaze trials than downward gaze trials, and exclusion did not increase the delay in direct gaze trials. Instead, we discovered that, in the social inclusion group, the response times were longer for direct gaze trials relative to downward gaze trials. Thus, social inclusion might have activated affiliation-related cognitive processes leading to delayed attentional disengagement from faces cueing affiliation.

Introduction

Social exclusion threatens the fundamental human need to belong (Williams, 2007), lowers mood (Gerber & Wheeler, 2009) and elicits social pain (MacDonald & Leary, 2005). Excluded individuals have an acute need to regain other people's acceptance (Smart Richman & Leary, 2009; Williams, 2007), and thus they may exhibit affiliative behavior, such as increased conformity (Williams, Cheung, & Choi, 2000) and nonverbal mimicry (Lakin, Chartrand, & Arkin, 2008). Interestingly, when people are socially excluded, they become more efficient in processing of social information, leading to, for instance, increased acuity in identification of facial expressions (Bernstein, Young, Brown, Sacco, & Claypool, 2008), and enhanced memory for social information (Gardner, Pickett, & Brewer, 2000). These findings suggest that excluded individuals allocate a large amount of attentional resources toward socially salient information.

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Attentional deployment consists of several different processes such as shifting, engagement, and disengagement of attention (Posner & Petersen, 1990). When an unattended stimulus attracts attention, an individual may shift attention towards it. Some categories of stimuli, such as faces, attract attention more than others so that when several stimuli compete for attention, it is more likely that attention is shifted to these stimuli (Langton, Law, Burton, & Schweinberger, 2008). Biases in the initial shifts of attention toward stimuli belonging to specific categories have been suggested to help in rapid detection of important stimuli (e.g., Cisler & Koster, 2010). After a shift of attention, attention can be engaged by the stimulus, allowing deeper processing of relevant stimulus features. When a novel stimulus suddenly demands attention, attention has to be disengaged from the attended stimulus. Research has revealed that attentional biases can also occur at the stage of attentional disengagement so that disengagement from specific categories of stimuli is delayed. For instance, disengagement is slower from faces than from non-social control pictures (Bindemann, Burton, Hooge, Jenkins, & Haan, 2005), and individuals suffering from anxiety have difficulties in disengaging attention from threatening stimuli (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007).

To cope with exclusion, people often allocate attention toward affiliative cues containing information that is particularly important for individuals whose social status is threatened. For instance, in studies where participants have been presented with two faces with different facial expressions, exclusion has been shown to increase the tendency to shift attention toward a smiling face (DeWall, Maner, & Rouby, 2009, Experiment 4; Tanaka & Ikegami, 2015; Xu et al., 2015). It has also been reported that excluded participants are faster than controls in locating smiling faces, but not other emotional faces, from a crowd of faces (DeWall et al., 2009, Experiment 1; but see Tuscherer et al., 2015). Other studies have presented participants simultaneously with several different emotional faces over a period of time, and found that excluded participants, compared to control groups, fixate more on smiling faces, but not other emotional faces (Buckner, DeWall, Maner, & Schmidt, 2010; DeWall et al., 2009, Experiments 2–3; but see Kraines, Kelberer, & Wells, 2018). These findings suggest that excluded individuals tend to shift their attention toward smiling faces, and engage their attention with these faces, possibly because attending to affiliative cues helps them cope with the adverse experience.

Not only facial expressions, but also eye gaze is an important social cue to signal affiliation or exclusion. Direct gaze (gaze directed at the observer's eye region) indicates that the observer is in the center of the looker's attention (Conty, George, & Hietanen, 2016). Seeing another's direct gaze evokes positive affective responses in the perceiver (e.g., Chen, Helminen, & Hietanen, 2017; Chen, Peltola, Ranta, & Hietanen, 2016; Hietanen et al., 2018), and activates brain mechanisms related to approach motivation (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008). Gaze aversion, on the other hand, is a common way to indicate social exclusion (Williams, Shore, & Grahe, 1998), and it can indeed evoke feelings of exclusion and relational devaluation in the observer (Leng, Zhu, Ge, Qian, & Zhang, 2018; Wirth, Sacco, Hugenberg, & Williams, 2010).

Exclusion has been found to modulate responses to others' gaze directions. In a recent study, participants were excluded or included in a virtual ball-tossing game Cyberball (see Williams & Jarvis, 2006), which was played ostensibly with other participants present in the laboratory (Lyyra, Wirth, & Hietanen, 2017). After the manipulation, participants judged whether faces with varying gaze directions were looking at them or not. It was discovered that excluded participants, compared to included participants, were biased to view others as portraying direct gaze, suggesting that they viewed others as signaling affiliation with their gaze. However, another study showed that when this game was played ostensibly online with players located in other laboratories, excluded participants tended to judge others as portraying averted gaze instead (Syrjämäki, Lyyra, & Hietanen, 2018). It was suggested that this was because the online setting offered no opportunity for reaffiliation. Exclusion has also been shown to amplify attentional shifts triggered by other people's gaze. Wilkowski, Robinson, and Friesen (2009) showed that the gaze-cuing effect (the tendency to shift attention toward others' gaze directions) was larger among individuals with low self-esteem, compared to high self-esteem (Experiment 1), and among participants who had reflected on social exclusion, as compared to those having reflected on inclusion (Experiment 2).

As well as averted gaze, also direct gaze influences perceivers' attention. Faces portraying direct gaze attract attention more than faces showing other gaze directions (e.g., Böckler, van der Wel, & Welsh, 2014; Conty, Tijus, Hugueville, Coelho, & George, 2006; Lyyra, Astikainen, & Hietanen, 2018; von Grünau & Anston, 1995). Importantly, it has also been suggested that direct gaze holds the perceiver's visuospatial attention so that attentional disengagement from the face is delayed. This was proposed based on a result that manual response times in detection of peripheral stimuli were longer when participants were shown, in the fixation, a face portraying direct gaze compared to downward gaze or closed eyes (Senju & Hasegawa, 2005). Similarly, a later study reported that delays in saccades to peripheral stimuli were longer from schematic faces suddenly shifting eyes into direct gaze, compared to faces shifting gaze upward or downward (Ueda, Takahashi, & Watanabe, 2014). In another study measuring saccadic latencies and saccadic peak velocities to peripheral targets after pictures of faces with static direct gaze and closed eyes, there was no effect of gaze direction on saccadic latencies, but compatible with the previous studies suggesting delayed attentional disengagement, the peak velocity of the saccades was lower after faces with direct gaze (Dalmaso, Castelli, & Galfano, 2017). Interestingly, however, a recent study found that manual response times in the identification of peripheral stimuli were shorter, not longer, when participants viewed live faces portraying direct gaze, compared to downward gaze (Hietanen, Myllyneva, Helminen, & Lyyra, 2016). The authors suggested that eye contact with the live person increased physiological arousal, and this led to shortened response times after direct gaze stimuli. Thus, the current evidence suggests that only pictures of faces with direct gaze, but not real faces portraying direct gaze, slow down disengagement of attention from the stimulus.

If pictures portraying faces with direct gaze hold perceivers' visuospatial attention, this effect might be amplified by social exclusion. As exclusion increases allocation of attention to affiliative cues (e.g., DeWall et al., 2009), and amplifies attentional shifts triggered by averted gaze (Wilkowski et al., 2009), it could be expected that the attention holding effect of direct gaze might be particularly strong among excluded individuals. This should lead to further slowing of response times to peripheral target stimuli in the context of direct gaze, as compared to downward gaze.

In the current study, we manipulated participants' feelings of social exclusion and social inclusion using Cyberball (Williams & Jarvis, 2006), followed by a similar attentional disengagement task as that used by Senju and Hasegawa (2005). In the widely used Cyberball manipulation, participants engage in a virtual ball-tossing game ostensibly with other individuals. Unbeknownst to the participants, the other characters in the game are actually controlled by the computer and are preprogrammed to either include the participants in the game or exclude them from it. Exclusion from this game, compared to inclusion, consistently evokes affective responses associated with social exclusion, such as lowered satisfaction of basic social needs (Hartgerink, van Beest, Wicherts, & Williams, 2015).

A limitation of most studies using the Cyberball manipulation is that they cannot disentangle the effects of social exclusion from the effects of social inclusion. In a typical experiment, excluded participants are compared to included participants, and any differences between the two groups are inferred to reflect effects of social exclusion. However, without a control group it is impossible to determine whether exclusion, inclusion or both caused the observed differences. In the current study, we included a non-social control group, in which participants played a similar ball-tossing game as in the other groups, but the game contained no social interaction (the manipulation has been previously used in Syrjämäki et al., 2018).

The non-social control group also allowed us to investigate the possibility that social inclusion could also slow down attentional disengagement from direct gaze. It has been shown that social inclusion, but not social exclusion, increases interest in mating (Brown, Young, Sacco, Bernstein, & Claypool, 2009; Sacco, Brown, Young, Bernstein, & Hugenberg, 2011). If inclusion can alter social behavior, then it might influence the allocation of attention to social cues as well. Recent evidence shows that the effect of direct gaze, compared to downward gaze, on self-reported arousal is stronger when participants have been primed with affective sentences related to positive social interactions, or social interactions involving the self, compared to negative interactions, or interactions involving other individuals, respectively (McCrackin & Itier, 2018). This suggests that activation of affiliation-related cognitive processes can cause an observer to experience another's direct gaze as a particularly potent and salient cue. Furthermore, one study found that participants induced with positive mood made more eye contact than participants induced with negative or neutral mood (Natale, 1977). Based on these findings, it seems possible that a positive social experience such as an inclusive social interaction could also modulate responses to others' gaze, and thus possibly slow down disengagement of attention from faces with direct gaze. On the other hand, only one study has found inclusion in Cyberball causing effects compared to a condition with no manipulation (increased interest in mating; Brown et al., 2009), whereas several studies have found no differences on various measurements when comparing inclusion to non-social control manipulations (Dvir, Kelly, & Williams, 2018; Riva, Williams, Torstrick, & Montali, 2014; Syrjämäki et al. 2018). Thus, exclusion would be more likely to exert an effect on attentional disengagement from direct gaze than social inclusion.

After the social exclusion, social inclusion, or control manipulation, participants completed a task, in which we examined attentional disengagement from faces. We used realistic, computer-generated face stimuli. These kinds of face stimuli have proved useful substitutions for photographs in studies on attention to faces because they provide precise control over many important properties of the stimuli, such as their gaze direction, head orientation, and facial expression (e.g., Becker, Anderson, Mortensen, Neufeld, & Neel, 2011). Similar to earlier research on attentional disengagement from direct gaze, the faces were rotated laterally (Hietanen et al., 2016; Senju & Hasegawa, 2005). In the attentional disengagement task, participants were first shown a face portraying direct or downward gaze in the middle of the computer screen, and after a brief delay (200 ms or 500 ms), a target stimulus appeared on either the left or the right side of the face. Participants were instructed to identify the target stimulus as quickly as possible using one of two keys on a keyboard. We hypothesized that participants in all groups would be slower to identify the target stimuli when presented with a picture of a face portraying direct gaze as compared to downward gaze. Most importantly, we investigated whether social exclusion, and possibly social inclusion, would enhance this effect. We hypothesized that the difference in response times between direct and downward gaze trials would be larger in the social exclusion group, compared to the non-social control group, which would indicate that excluded participants' attention is particularly strongly held by direct gaze. As described above, there was some basis to expect that the attention holding effect by direct gaze could be enhanced also in the included individuals relative to the control group.

Method

Participants

74 participants (26 males, $M_{age} = 25.4$ years, $SD_{age} = 6.8$) with self-reported normal or corrected to normal vision, and no psychiatric or neurological disorders, volunteered for the experiment. They were randomly assigned to exclusion, inclusion, and non-social control groups. Our aim was to get 20 participants in each condition in the final sample (as suggested by Simmons, Nelson, & Simonsohn, 2011). We

excluded a number of participants because they indicated awareness of the deception in the Cyberball manipulation (see "Data analysis" section for details). These participants were replaced to ensure the final sample only consisted of participants not aware of the deception, with sufficient number of participants in each group. The final, analyzed sample after all data exclusions, consisted of 62 participants ($n_{\text{exclusion}} = 21$, $n_{\text{inclusion}} = 21$, $n_{\text{control}} = 20$, 21 males, $M_{\text{age}} = 24.8$ years, $\text{SD}_{\text{age}} = 6.0$). All participants signed a form of informed consent and were rewarded with either a movie ticket or partial course credit.

Apparatus

All stimuli were presented on a 19″ LCD monitor with a resolution of 1280 × 1024 and a refresh rate of 60 Hz. Participants' head position was fixed at 57 cm from the monitor using chin and forehead rests. The experiment was run using E-Prime® 2.0 software. The Cyberball game was presented on a Firefox Internet browser. Participants gave responses using standard keyboards. The right bracket key and the w key were marked with a horizontal line and a vertical line (order counterbalanced across participants) and were used as the response keys in the attentional disengagement task. To align the response keys horizontally, the keyboard was rotated 90° clockwise. To prevent distractions, participants wore acoustic earmuffs during the experiment.

Social exclusion, social inclusion, and control manipulations

We used three versions of Cyberball 4.0 (Williams & Jarvis, 2006) for the social exclusion, inclusion, and control manipulations. In the inclusion and exclusion conditions, three characters, one controlled by the participant, were throwing a ball with each other. Participants in the inclusion condition received approximately one-third of all tosses. Participants assigned to the exclusion condition only received the ball once from each character in the beginning of the game, and then never again. The game lasted for 30 throws in total. In the control condition, the other two characters were replaced by pictures of baskets, in which the participants were throwing the ball. After each throw, the ball returned to the participant's character. Participants in the control condition made 10 throws, i.e., the same number as in the inclusion condition. The game pace was adjusted to ensure the length of the game was similar in all conditions.

Stimuli

The face stimuli in the attentional disengagement task were faces of four virtual characters (two females), created with 3D animation software DAZ Studio. The whole head, including the neck, was displayed. The characters were rotated 20° on a vertical axis. The eyes in the direct gaze stimuli were individually rotated so that the pupils pointed directly at the camera. The eyes in the downward gaze stimuli were rotated similarly on the vertical axis, but they pointed 24.1° down. The stimuli were 11.7° (± 0.4°) high, and 8.1° (± 0.8°) wide. The target stimuli were horizontal and vertical lines, 1.3° of visual angle.

Attentional disengagement task

Each trial in the attentional disengagement task began with showing a fixation cross in the middle of the screen. After a random delay between 650 ms and 850 ms, the fixation cross was replaced with the face stimulus. The stimulus was positioned so that both eyes were at the same distance from the center of the screen. After a stimulus onset asynchrony (SOA) of 200 ms or 500 ms, the target stimulus appeared on either the left or the right side of the face (15.5° from the center of the screen). Participants were instructed to press the corresponding response key as fast as possible while trying not to make mistakes. If the participant did not respond within 2000 ms, the next trial was presented. The interstimulus interval was a random duration between 800 ms and 1200 ms. See Fig. 1 for an illustration of a single trial.

Participants completed two blocks of trials, each containing two of each possible combination of the factors of face identity, gaze direction, SOA, target stimulus, and target side. This resulted in two blocks of 128 trials each. The trial order was pseudorandomized so that there were no more than four successive repetitions on any of the factors. In one of the blocks, horizontally flipped face stimuli were displayed (order counterbalanced across participants). In between the blocks, participants were allowed to take a short break.

Procedure

Participants arrived in the laboratory in groups of three. They were instructed by a female experimenter, blind to the condition each participant was assigned to. As a cover story, participants were told the study was about "mental visualization" and attention. They were told that they would do a mental visualization task, followed by an attention task. To enhance the cover story, participants filled in a bogus mental visualization questionnaire in the beginning of the experiment. After this, they completed a 16-trial practice block of the attentional disengagement task, followed by the Cyberball manipulation, described above. The instructions for the game were presented on the computer screen. Participants in the exclusion and inclusion conditions were told that the game would be played with the other two participants present in the laboratory via a local area network.

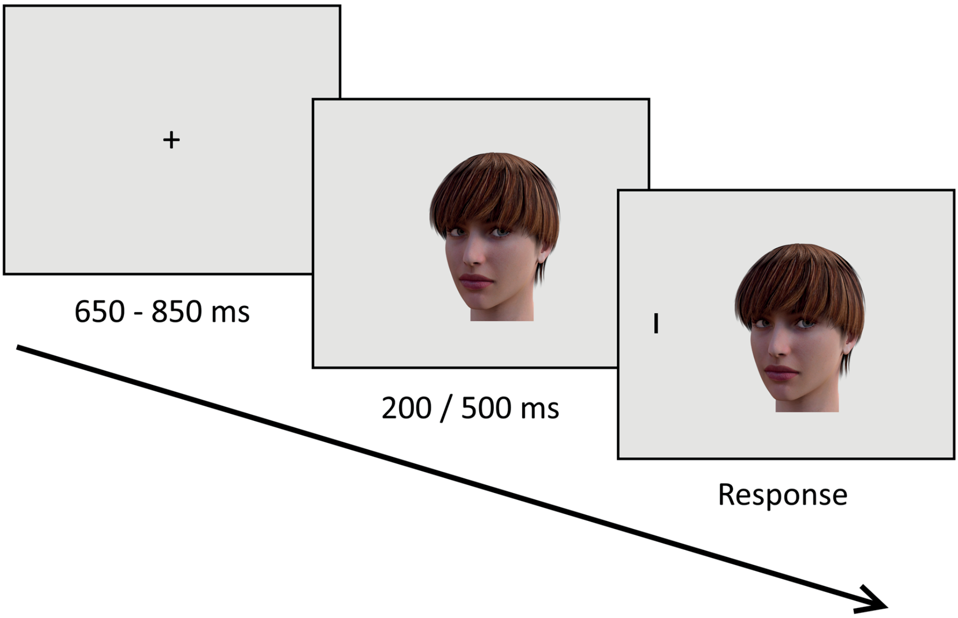

Fig. 1 Illustration of a single trial in the attentional disengagement task. A fixation cross was displayed for 650–850 ms, after which a face stimulus (portraying direct or downward gaze) appeared on the screen. After 200 ms or 500 ms (SOA), the target stimulus (either a horizontal or a vertical line) was displayed on the left or the right side of the face. Participants were instructed to identify the target stimulus as quickly as possible using one of two keys on the keyboard. The displayed stimuli are not to scale

In reality, the other characters in the game were controlled by the computer.

After the manipulation, we evaluated its effectiveness by administering a six-item questionnaire measuring fulfillment of basic social needs of control ("I felt I had the ability to significantly alter events"), meaningful existence ("I felt important"), belonging ("I felt rejected"), and self-esteem ("I felt insecure"), as well as positive mood ("I felt happy"), and negative mood ("I felt angry"). The items were chosen from a questionnaire used in previous social exclusion studies (e.g., Molet, Macquet, Lefebvre, & Williams, 2013; Wirth & Williams, 2009). The questionnaire was abbreviated, because the effects of exclusion in Cyberball have been found to diminish quickly (e.g., Lyyra et al., 2017; Wesselmann, Wirth, Mroczek, & Williams, 2012), and thus it was important to ensure the interval between the manipulation and the attentional disengagement task was as short as possible. We reverse-scored the basic need scores when necessary, and averaged them to calculate a basic need satisfaction score for each participant ($\alpha = 0.78$). The participants also rated the amount of pain they were experiencing during the game on a 0–100 scale. As a manipulation check, they assessed what percentage of all throws in the game was made by them. After the questionnaire, participants performed the attentional disengagement task, described earlier.

After completing the task, we measured participants' awareness of the deception in the Cyberball manipulation with a funnel-type suspicion questionnaire (the method has been previously used in Syrjämäki, Lyyra, Peltola, & Hietanen, 2017, Experiment 2). Participants typed out their answers to six questions, which started with vague questions about the experiment and ended with asking explicitly about their suspicions. We inferred that the more suspicious the participants were, the more likely they would voice their suspicions, even spontaneously to vague questions. The questions were as follows: (1) How did you feel about the experiment? (2) What do you think the experiment was about? (3) What do you think was the purpose of the ball game you played? (4) Was there anything confusing or odd about the ball game? (5) Do you think there was something about the ball game the experimenter did not tell you about? If yes, what was it? (6) If the experimenter would now tell you that she misled you with something about the ball game, what do you think she would tell you? After all participants were finished with the questionnaire, they were thoroughly debriefed, rewarded, and thanked for their participation.

Table 1 Manipulation check, basic need, mood, and pain scores for each experimental group, and statistics for the between-groups comparisons

	Exclusion *M* (SD)	Inclusion *M* (SD)	Control *M* (SD)	Kruskal–Wallis test		Pairwise comparisons					
						Exclusion-inclusion		Exclusion-control		Inclusion-control	
				$\chi^2(2)$	*p*	*U*	*p*	*U*	*p*	*U*	*p*
Manip. check	11.0 (6.1)	36.6 (8.0)	83.3 (31.2)	42.84	< 0.001	0.50	< 0.001	29.00	< 0.001	45.00	< 0.001
Basic needs	2.01 (0.84)	3.85 (0.65)	3.46 (0.78)	30.92	< 0.001	29.00	< 0.001	40.50	< 0.001	136.50	0.054
Pos. mood	2.14 (1.06)	3.67 (1.24)	3.10 (1.21)	14.49	0.001	82.50	< 0.001	116.00	0.011	151.00	0.108
Neg. mood	2.29 (1.19)	1.10 (0.30)	1.20 (0.52)	21.30	< 0.001	85.50	< 0.001	93.50	0.001	197.50	0.556
Pain	24.4 (23.3)	1.5 (3.8)	6.0 (16.8)	17.11	< 0.001	82.50	< 0.001	97.50	0.002	197.50	0.685

Manipulation check and pain scores are on a 0–100 visual analogue scale; basic need and mood scores are on a 1–5 Likert scale; pairwise comparisons done with Mann–Whitney *U* test

Data analysis

Suspicion

Each item in the suspicion questionnaire was scored 1 if the participant indicated awareness that the course of the Cyberball game was predetermined, or that the game was not played with the other participants. An item was scored 0 if the participant did not indicate such awareness. Thus, we received an ordinal scale suspicion score, ranging from 0 to 6 for each participant.

Data exclusions

From the total sample of 74 participants, we excluded 12 participants before the analyses. Before analyzing the data, we decided to remove all participants who received suspicion scores of 3 or higher (11 participants, 2 in the inclusion group, 9 in the exclusion group), as we considered them aware of the deception in Cyberball. Exclusion of suspicious participants did not influence the statistical significance of the analyses. Finally, we excluded one participant (in the control group) as an outlier. For this participant, the difference in response times between direct and downward gaze trials in the attentional disengagement task was very large (41 ms longer for direct gaze trials, more than three standard deviations higher than the mean difference in the sample).

Attentional disengagement task

For analysis of the response times, we first removed all trials in which participants did not respond (< 0.1% of all trials), trials with incorrect responses (3.8% of all trials), and trials with response times (RTs) not within 2.5 SD from the individual mean (2.6% of the remaining trials). We then calculated individual mean RTs for each combination of SOA, Gaze Direction, and Block Position. For the statistical analyses, we performed a square root transformation to correct for non-normal distribution of the data. For the sake of clarity, untransformed values are presented in the figures and text in the "Results" section. For analysis of the error rates, we calculated the total number of incorrect responses in each combination of SOA, Gaze Direction, and Block Position for each participant. For the statistical analyses, these values were square root transformed to reduce skewness. For the sake of clarity, untransformed values are presented in the "Results" section.

Results

Questionnaires

The means and standard deviations for manipulation check, basic need, mood and pain scores for each experimental group, as well as statistics for the between-group comparisons are presented in Table 1. Because the data violated normality assumptions of parametric tests, the comparisons were conducted using non-parametric Kruskal–Wallis tests, and the follow-up pairwise comparisons using Mann–Whitney *U* tests.

To summarize, these results show that participants experienced the social exclusion and inclusion manipulation as intended. Participants were aware of their inclusionary status, as the manipulation checks showed that the control group reported making a larger proportion of the throws than the inclusion or the exclusion groups, and the inclusion group reported making a larger proportion of the throws than the exclusion group. Exclusion also elicited the expected affective responses: participants in the exclusion group reported less basic need satisfaction and positive mood, and more negative mood and pain than either the inclusion or the control group. There were no differences between the inclusion and control groups on these measurements, although the difference in basic need satisfaction was approaching statistical significance.

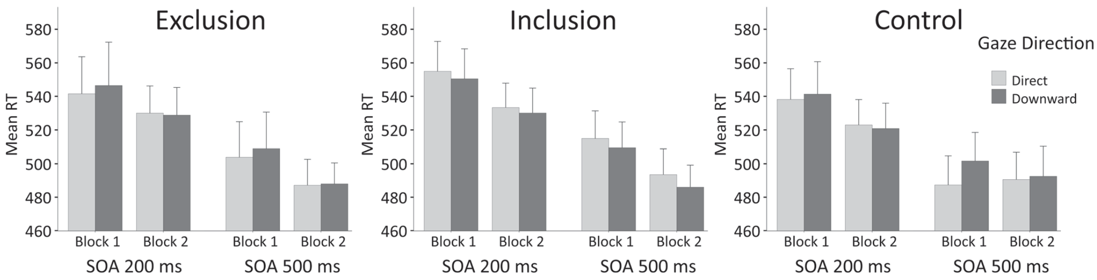

Fig. 2 Mean response times in milliseconds in each condition. The error bars stand for standard error of the means

Response times in the attentional disengagement task

The response time data were analyzed using a 3 (inclusionary Status: inclusion/exclusion/control; between subjects factor) × 2 (gaze direction: direct/down; within subjects factor) × 2 (SOA: 200 ms/500 ms; within subjects factor) × 2 (block position: block 1/block 2; within subjects factor) mixed-design ANOVA, with response time (RT) as the dependent variable. For RTs divided by each of these factors, see Fig. 2.

The analysis revealed a significant effect of SOA (F(1, 59) = 235.42, $p < 0.001$, $\eta_p^2 = 0.80$). RTs were longer for trials at a SOA of 200 ms ($M = 536.7$, SD = 77.7), as compared to trials at a SOA of 500 ms ($M = 497.0$, SD = 71.3). Shortening of the RTs as a function of the SOA is a typical finding that reflects subjective expectancy, among other things (for a review, see Niemi & Näätänen, 1981). The main effect of Block Position was also significant (F(1, 59) = 10.91, $p = 0.002$, $\eta_p^2 = 0.16$). RTs were longer in block 1 ($M = 525.0$, SD = 85.3) than in block 2 ($M = 508.7$, SD = 66.2), suggesting that performance in the task improved with repetition. No main effects of gaze direction or inclusionary status were found ($ps > 0.73$).

The most important finding was an interaction between inclusionary status and gaze direction (F(2, 59) = 3.97, $p = 0.024$, $\eta_p^2 = 0.12$; see Fig. 3). To break down this interaction, we conducted a series of t tests. They revealed that, in the exclusion and control groups, there were no statistically significant differences between RTs in direct and downward gaze trials (exclusion group: $t(20) = 0.77$, $p = 0.452$, $d = 0.16$; control group: $t(19) = 1.89$, $p = 0.074$, $d = 0.44$), whereas the RTs were longer for direct than downward gaze trials in the inclusion group ($t(20) = 2.41$, $p = 0.026$, $d = 0.56$). No between-group differences for RTs in direct or downward gaze trials were found ($ps > 0.50$). We found no other interactions (highest F was for inclusionary status × SOA × block position interaction, F(2, 59) = 2.18, $p = 0.123$, $\eta_p^2 = 0.07$).

Error rates

For analysis of the error rates, we conducted a similar mixed-design ANOVA as in the analysis of the RT data. The only statistically significant effect was an interaction between gaze direction and SOA (F(1, 59) = 5.34, $p = 0.024$, $\eta_p^2 = 0.08$; all other $ps > 0.08$). t tests revealed that, at the SOA of 200 ms, participants made more errors on direct gaze trials ($M = 1.40$ errors, SD = 1.18) compared to downward gaze trials ($M = 1.15$ errors, SD = 1.38; $t(61) = 2.21$, $p = 0.031$, $d = 1.26$). Participants also made more errors on direct gaze trials at the SOA of 200 ms than at the SOA of 500 ms ($M = 1.15$ errors, SD = 1.26; $t(61) = 2.19$, $p = 0.032$, $d = 0.43$). There were no differences in the number of errors between direct gaze trials at the 500-ms SOA, downward gaze trials at the 500-ms SOA ($M = 1.22$ errors, SD = 1.27), and downward gaze trials at the 200-ms SOA ($ps > 0.33$).

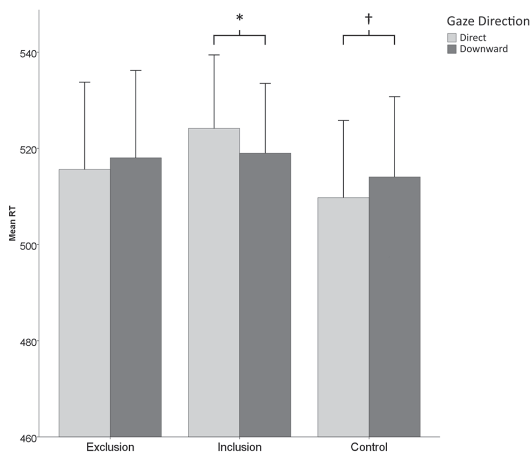

Fig. 3 Mean response times in milliseconds in each experimental group on direct and downward gaze trials, averaged over the two SOAs and blocks. The error bars stand for standard error of the means. $^*p < 0.05$, $^\dagger p < 0.10$

These results suggest that participants were especially prone to make errors on direct gaze trials at the short SOA, possibly because direct gaze takes up the perceiver's cognitive resources (see Conty, Gimmig, Belletier, George, & Huguet, 2010), consequently hindering performance in tasks that require rapid deployment of cognitive resources.

Discussion

In the present study, we investigated whether the attentional holding effect of direct gaze (see Senju & Hasegawa, 2005) would be enhanced by social exclusion, and possibly also by social inclusion. We hypothesized that participants in all groups would be slower to identify the target stimuli when presented with a face portraying direct gaze relative to downward gaze, but more importantly, we hypothesized that this difference in response times would be larger among socially excluded participants than in the non-social control group. Neither of these hypotheses were supported. The results showed that, in the control and exclusion groups, the response times tended to be shorter for direct gaze trials than downward gaze trials. We also investigated the possibility that social inclusion would delay the disengagement of attention from faces with direct gaze. Consistent with this, we found that, in the inclusion group, the response times were significantly longer for direct gaze trials than downward gaze trials. In summary, we received no support for that direct gaze would typically delay attentional disengagement, and that this delay would be increased after an exclusion manipulation. Instead, we observed that it was the inclusion manipulation which caused delayed disengagement of attention from faces with direct gaze compared to downward gaze.

Exclusion and attentional disengagement

As noted above, social exclusion did not influence attentional disengagement from direct gaze, in the present study. The exclusion manipulation as such was effective, as exclusion, compared to inclusion and the non-social control group, lowered mood and satisfaction of basic social needs, and increased self-reported pain, as in earlier research (e.g., Hartgerink et al., 2015; Williams et al., 2000; Wirth, Lynam, & Williams, 2010). Several researchers have suggested that exclusion increases the level of attention allocated to socially salient information (e.g., Pickett, Gardner, & Knowles, 2004; Shilling & Brown, 2016), and previous research has found increased attention toward affiliative cues, such as smiling faces, among excluded participants (e.g., DeWall et al., 2009). Just like facial expressions, also other people's gaze is an important cue that excluded individuals use to navigate in their social environment. This is evidenced by findings that exclusion alters gaze direction judgments according to the individual's motivational states (Lyyra et al., 2017; Syrjämäki et al., 2018), and that reflecting on exclusion, compared to inclusion, enhances attention shifts toward the direction of another person's gaze (Wilkowski et al., 2009). Nevertheless, the exclusion manipulation did not delay the disengagement of attention from direct gaze. Perhaps excluded individuals do not maintain their attention in faces with direct gaze, because seeing direct gaze may not reduce the affective distress elicited by exclusion (see Syrjämäki et al., 2017). Attending to smiling faces, on the other hand, could be an effective way of regulating one's affective state and therefore many people may have learned to habitually direct their attention toward smiling faces, and maintain their attention in these cues, as a response to exclusion.

Another possible interpretation of our finding is that exclusion does not exert its influence at the attentional disengagement stage. Previous research has investigated how exclusion modulates attentional shifts toward facial expressions (e.g., Tanaka & Ikegami, 2015), and fixation times to emotional faces (e.g., DeWall et al., 2009, Experiments 2–3), as well as performance in visual search for different facial expressions (e.g., DeWall et al., 2009, Experiment 1). However, the current experiment is the first to investigate how exclusion modulates attentional disengagement from a social cue[1]. Thus, it is possible that exclusion facilitates attentional shifts toward affiliative cues and engagement of attention with these cues (see DeWall et al., 2009), but does not slow down disengagement from them. Of course, we cannot draw firm conclusions because there are significant differences between this and earlier studies, such as in the types of stimuli used (emotional faces versus faces with different gaze directions). Future research should investigate whether exclusion modulates the tendency to shift attention toward faces with direct gaze (e.g., Böckler et al., 2014; von Grünau & Anston, 1995), and disengagement of attention from faces showing different facial expressions. This would provide a more detailed understanding of the time-course of the effects of exclusion on attention to different types of social cues.

[1] DeWall et al. (2009, Experiment 4) investigated the effects of exclusion on attention to different facial expressions using a dot-probe task. They interpreted their result as indicating that exclusion modulated attentional disengagement from a smiling face, but not the speed at which attention was engaged with a smiling face. However, the dot-probe task used in that experiment only reveals which of two stimuli (a neutral face or an emotional face) attention was focused on at the time the target probe was presented (1 s after presentation of the faces in that experiment), and thus it cannot distinguish between effects at different stages of attentional deployment (see Cooper & Langton, 2006). Thus, the current experiment is in fact the first to specifically investigate the effects of exclusion on attentional disengagement from a social stimulus.

It should be noted that, based on the present study, we cannot conclusively determine that exclusion did not modulate attentional disengagement from faces, in general, even though there were no differences in the response times between the groups. A limitation of the present experiment is that we did not include non-social control stimuli in the attentional disengagement task. Exclusion could have speeded up response times to targets generally, while simultaneously it may have slowed down attentional disengagement from face stimuli specifically. For instance, it has been shown that exclusion increases autonomic arousal (see Kelly, McDonald, & Rushby, 2012), which could generally speed up reaction times. If exclusion simultaneously slowed down disengagement of attention from faces, regardless of their gaze direction, these two opposite effects could have canceled each other out, so that no effect of the manipulation on response times was observed. However, based on previous research, there is no reason to assume that exclusion modulated attentional disengagement from all faces. No study to date has shown that excluded individuals allocate increased levels of attention to all types of face stimuli, but instead they tend to allocate more attention to specific types of faces, such as those who are portraying a smiling expression (e.g., DeWall et al., 2009; Tanaka & Ikegami, 2015).

Inclusion and attentional disengagement

Interestingly, and somewhat surprisingly, our results showed that social inclusion had an effect on attentional disengagement, as the response times were longer in trials with direct gaze compared to downward gaze, when the attentional disengagement task followed an inclusive social interaction, but not after social exclusion or a non-social control task. This result suggests that social inclusion does not only increase interest in mating behavior (Brown et al., 2009; Sacco et al., 2011), but it also modulates allocation of attention to social cues. The finding was surprising, however, as we originally predicted that exclusion would be more likely than inclusion to influence attentional disengagement. One possible explanation to this finding is that social inclusion activated affiliation-related cognitive processes, which modulated responses to direct gaze. A recent study suggested that the experiential responses evoked by direct gaze are particularly powerful when participants have been primed with affective sentences related to positive social interactions or interactions involving the self, relative to negative interactions or interactions involving other people, respectively (McCrackin & Itier, 2018). Similarly, an inclusive social interaction could activate affiliation-related cognitive processes, and cause the individual to experience direct gaze as a particularly salient cue. Thus, increased allocation of attention to faces portraying direct gaze would make it difficult to disengage attention from the face.

An alternative possibility is that activating cognitive contents related to social inclusion increased attention to stimuli belonging to this category of social behavior. For instance, it has been reported that participants who wrote about a specific ethnic group showed faster visual search for faces belonging to that group compared to participants who had written about a different ethnic group (Chiao, Heck, Nakayama, & Ambady, 2006). Similarly, being included in a social interaction could cause the individual to allocate more attention to affiliative stimuli, and consequently delay disengagement of attention from these stimuli.

Future research could directly test whether a priming effect explains the delayed attentional disengagement from direct gaze. For instance, participants could be primed with sentences related to social acceptance and with non-social control sentences followed by measurements of attentional disengagement from direct and downward gaze. It would be expected that direct gaze, compared to downward gaze, would hold attention only when preceded by primes related to affiliation. Furthermore, if the effect was caused by a prime activating cognitive processes related to the category of the perceived stimulus, then a similar effect on attentional disengagement might occur by priming different types of categories of stimuli as well. Primes related to, for instance, animals, might lead to delayed attentional disengagement from pictures of animals, compared to control stimuli such as pictures of plants. This hypothesis could be investigated in future research to determine if the effect of social inclusion on attentional disengagement from direct gaze reflects a typical response to various types of primes and stimuli, or if this response is specific to affiliative social cues followed by affiliation-related affective priming.

Even though we have interpreted our results in the context of attentional engagement, is it possible that the observed difference in response times between direct and downward gaze trials can be explained by some other effects? This seems improbable, as several alternative explanations can be ruled out. First, we can rule out the possibility that the difference in response times would reflect the effect of gaze direction on autonomic arousal. It has been demonstrated that gaze direction in pictures of faces does not influence autonomic arousal, unlike gaze direction in live faces (e.g., Hietanen et al., 2008; Pönkänen, Peltola, & Hietanen, 2011). Even if the face stimuli had influenced autonomic arousal in this experiment, direct gaze would have been expected to increase arousal, which in turn, should have led to shortening rather than lengthening of the response times. Second, the effect was not likely caused by the manipulation altering socially included participants' perceptions of gaze directions. Previous research has shown that social exclusion modulates judgments of others' gaze directions, but importantly, social inclusion does not (Lyyra et al., 2017; Syrjämäki et al., 2018). Thus, if the modulation of response times would have reflected changes in perception of gaze directions, we should have observed the effect of gaze in the social exclusion group, rather than in the social inclusion group. Finally, it is unlikely that the difference in response times was due to included participants having difficulties in making a saccade from the faces to the target stimuli, rather than having difficulties in disengaging attention as such. Attentional shifts precede saccades (Zhao, Gersch, Schnitzer, Dosher, & Kowler, 2012), and thus if the direct gaze stimuli only delayed oculomotor disengagement, but not attentional disengagement, participants' attention would have shifted to the target stimuli equally quickly on both types of trials. It is clear from previous research that responding to peripheral stimuli is possible without moving eyes away from a central stimulus (e.g., Hermens, 2015), and in the current study, the visual difference between the two target stimuli was discernible while fixating on the centrally presented face. Because participants were attempting to respond as quickly as possible, it is unlikely that they would have deliberately waited for the saccade before responding if their attention was already focused on the target stimulus.

Non-social control condition

From a methodological standpoint, the most important implication of the current study is that social inclusion is not always a suitable control condition when investigating the effects of social exclusion using the Cyberball manipulation. In a typical experiment using this manipulation, any differences between the exclusion and the inclusion groups are inferred to reflect effects of exclusion (Hartgerink et al., 2015). A growing body of evidence suggests that the effect of the manipulation on affect is indeed driven by exclusion and not inclusion (Dvir et al., 2018; Riva et al., 2014; Syrjämäki et al., 2018). The current results are consistent with these findings, as we found no statistically significant differences between included participants and the control group in basic need satisfaction, mood, or self-reported pain (although in basic need satisfaction, the difference was approaching statistical significance). Furthermore, previous research also shows that the effects of the manipulation on gaze direction judgments (Syrjämäki et al., 2018), and compliance (Riva et al., 2014) are caused by exclusion, and not inclusion. However, the current study shows that inclusion, but not exclusion in Cyberball modulated disengagement of attention from faces with direct gaze, compared to downward gaze. This shows that some of this manipulation's effects are driven by inclusion and, therefore, future research should use non-social control groups to firmly show that differences between exclusion and inclusion groups are driven by exclusion (for a similar argument, see Brown et al., 2009). However, we do not imply that previously reported effects of exclusion manipulations on attention are driven by inclusion, as many studies on this issue have used control groups other than social inclusion (e.g., Buckner et al., 2010; DeWall et al., 2009).

We propose that the non-social task used in this experiment provides an appropriate and convenient control condition for future studies investigating the effects of social exclusion and social inclusion using Cyberball. Other types of control manipulations have been used as well, but the manipulation used in the current study has a few strengths over them. Riva et al. (2014) instructed participants to mentally visualize natural scenery, and Dvir et al. (2018) showed participants pictures of trees, which they were instructed to mentally visualize and to click on them with a mouse to emulate the motor actions done during Cyberball. Like these tasks, the currently used control task was devoid of any social interaction, but unlike in these other control tasks, participants performed identical actions as in the standard version of Cyberball, i.e., mouse clicks to throw a ball in a simple computer game. Moreover, in this task, participants were not led to mentally visualize nature, which might evoke unwanted responses. Even passive viewing of natural scenes can improve the perceiver's affective state (e.g., Ulrich et al., 1991) and influence recognition of affectively congruent facial expressions (Hietanen, Klemettilä, Kettunen, & Korpela, 2007).

Direct gaze and attentional disengagement

An important finding of this study was that, in general, there were no significant differences in response times in identification of the target stimuli between direct and downward gaze trials, suggesting that direct gaze did not hold observers' visuospatial attention. A few other recent studies have also found convergent evidence. Dalmaso et al. (2017) reported that only in one out of three experiments, delays in saccades from faces to peripheral stimuli were longer in the context of direct gaze compared to downward gaze. In the other two experiments, the delays were similar for the two conditions (but see Ueda et al., 2014, for a finding that saccadic latencies were longer from faces suddenly shifting eyes toward the perceiver, compared to faces shifting gaze upward or downward). Strikingly, another recent study found that eye contact with a live confederate enhanced, rather than impaired, attentional disengagement as measured by manual response times to peripheral stimuli (Hietanen et al., 2016). In other words, the result was opposite to what Senju and Hasegawa (2005) reported. The authors suggested that the engagement of visual attention by direct gaze was possibly overridden due to increased physiological arousal elicited by eye contact with a live confederate and that the increased arousal also facilitated perceptual-motor processes involved in discriminating and responding to the visual targets.

A comparison between the original experiment by Senju and Hasegawa (2005) and the studies mentioned above is somewhat problematic because the stimuli (Hietanen et al., 2016) or the behavioral measurements (Dalmaso et al., 2017) differed from those used in the Senju and Hasegawa study. The current study provides the first reported replication attempt of the original finding, measuring manual response times and using pictorial face stimuli as in the original study. Critically, we included a 500-ms SOA condition, in which the difference in response times between the two gaze conditions was found earlier. Notably, there were differences between the tasks in the two studies as well. For instance, the current study used computer-generated face stimuli, whereas the original study used photographs. However, it seems unlikely that this difference explains the conflicting results, as previous studies have reported effects of direct gaze on saccadic latencies even when using unrealistic schematic faces (Ueda et al., 2014). We cannot, of course, rule out the possibility that the discrepant results are explained by some other difference between the tasks (such as the 3°-difference in the positioning of the target stimuli, or difference in the task demands, i.e., identification versus detection of the target stimuli), but we have no reason to believe this is the case.

One potential, albeit unlikely, explanation for why there was no general effect of direct gaze on attentional disengagement is that participants did not perceive the direct gaze stimuli as actually portraying direct gaze. Due to the Wollaston effect, an objectively direct gaze can appear averted when the head is rotated (see Langton, Watt, & Bruce, 2000). However, we believe it is unlikely that the Wollaston effect distorted perception of gaze directions in this experiment. While we did not directly assess whether participants perceived the faces as portraying direct gaze as intended, the answers to the open-ended questions in the post-experiment suspicion questionnaire suggest that they did. Nine participants explicitly indicated that the faces were occasionally portraying direct gaze, for instance by referring to the faces as "staring faces". Eleven more participants referred to the gaze directions more vaguely, so that it was not possible to determine where they thought the faces were looking at. Importantly, however, no participant explicitly indicated that the faces were portraying averted gaze, suggesting that the Wollaston effect did not influence gaze direction perception in this experiment.

It is also extremely unlikely that the failure to replicate the earlier result was due to low statistical power. Our experiment had a significantly larger sample size than the original study (62 participants after all data exclusions in the present study, 7 participants in the original study). Thus, our results strongly suggest that direct gaze does not generally slow down attentional disengagement from the face. However, while the experiment was well-powered to detect a general effect of direct gaze on attentional disengagement, it had less statistical power to detect effects of the exclusion and inclusion manipulations on the attentional disengagement, and thus findings regarding the effects of these manipulations should be interpreted more cautiously.

Conclusion

In the present study, we found no evidence that direct gaze would generally hold a perceiver's visuospatial attention, or that social exclusion would slow down attentional disengagement from direct gaze. Surprisingly, we found that a social inclusion manipulation modulated attentional disengagement; following inclusion, disengagement of attention was slower from faces with direct gaze compared to downward gaze.

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Compliance with ethical standards

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Ethical approval All procedures in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of the Tampere Region, and with the 1964 Helsinki declaration and its later amendments.

Informed consent Informed consent was obtained from all participants included in the study.

Data availability The dataset analyzed during the current study is not publicly available to not compromise participant consent, but is available from the corresponding author on reasonable request.

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The effects of social exclusion on processing of social information – A cognitive psychology perspective

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The effects of social exclusion on processing of social information – A cognitive psychology perspective

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In this article, we review the research investigating the effects of social exclusion on processing of social information. We look into this topic from the point of view of cognitive psychology aiming to provide a systematic description of the effects of exclusion on workings of different cognitive mechanisms involved in social information processing. We focus on four lines of inquiry. First, we present the research on the effects of exclusion on memory for social information. Second, we review studies, which have investigated how exclusion changes the way people view and evaluate their social environment. Third, we look into the research which has investigated whether exclusion modulates early social information processing at the perceptual level. Finally, we discuss the research on the effects of exclusion on attentional processes. Importantly, we also present gaps in our understanding on these issues and provide suggestions as to how future research could provide a more detailed view on how exclusion modulates social information processing.

Social exclusion[1] is detrimental and can lead to depression, alienation (Williams, 2007), and sometimes even to violent behaviour (Leary, Kowalski, Smith, & Phillips, 2003). Laboratory studies (for a review of research methods, see Wirth, 2016) show that even a brief episode of exclusion lowers mood (Gerber & Wheeler, 2009), causes social pain, which is analogous to physical pain (Eisenberger, Lieberman, & Williams, 2003), and elicits various behavioural responses, such as aggressive behaviour (Twenge, Baumeister, Tice, & Stucke, 2001) or affiliation-seeking behaviour (Maner, DeWall, Baumeister, & Schaller, 2007).

One intriguing line of research suggests that exclusion does not only elicit emotional, motivational, and behavioural responses, but also that it even modulates processing of social information. For instance, it has been reported that exclusion improves participants' acuity in determining others' facial expressions (Bernstein, Young, Brown, Sacco, & Claypool, 2008) and enhances memory for social, but not for non-social information (Gardner, Pickett, & Brewer, 2000). Other studies have found that exclusion influences attention, such as causing participants to selectively direct attention towards

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[1] *Researchers use various terms, such as ostracism, rejection, and social exclusion to refer to similar phenomena. The common characteristic of these phenomena is that they all threaten the fundamental human need to belong (Smart Richman & Leary, 2009). Discussing the distinctions between these phenomena is outside the scope of this article, and thus, we use the umbrella term social exclusion to refer to all related concepts (as in Blackhart, Nelson, Knowles, & Baumeister, 2009; Shilling & Brown, 2016, among others).*

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smiling faces (DeWall, Maner, & Rouby, 2009), and enhancing attention shifts triggered by others' averted gaze (Wilkowski, Robinson, & Friesen, 2009). It has also been reported that excluded individuals, compared to controls, evaluate social information in an altered way: For instance, they have been found to estimate interpersonal distance as being shorter (Knowles, Green, & Weidel, 2014), and to judge ambiguous social interactions as more threatening (DeWall, Twenge, Gitter, & Baumeister, 2009).

According to the most influential model in this field, humans have a social monitoring system, which activates when belongingness needs are unmet (Pickett & Gardner, 2005). Activation of the social monitoring system has been suggested to result in 'increased social monitoring' (Pickett & Gardner, 2005, p. 216) and 'greater processing of socially relevant information in the environment' (Gardner *et al.*, 2000, p. 494). The authors originally argued that the social monitoring system influences attention (Pickett & Gardner, 2005), but other researchers have later suggested that it might also modulate social information processing via another route, by modulating basic perceptual processes (Pitts, Wilson, & Hugenberg, 2014; Sacco, Wirth, Hugenberg, Chen, & Williams, 2011). To date, the research on this topic has not been thoroughly reviewed and critically discussed, and thus, there is currently no comprehensive view about what kinds of mechanisms mediate the effects of exclusion on social information processing.

In this article, we will review the research on the effects of exclusion on processing of social information. We will first present a typical cognitive psychology model of information processing, encompassing the main perceptual and cognitive stages involved in social information processing. We believe this is essential. The currently published literature on this topic, from the point of view of cognitive psychology, is often quite vague in differentiating on which processes different social manipulations exert their effects. For instance, researchers do not always make a clear distinction between perceptual and attentional level processes (DeWall, Maner, & Rouby, 2009; Tanaka & Ikegami, 2015), or between perception and the entailing judgements (Knowles *et al.*, 2014; Pitts *et al.*, 2014). Moreover, some terms are vaguely used as follows: For instance, 'sensitivity' has been used to refer to discrimination accuracy (as the term is typically used in signal detection theory [SDT]; Bernstein *et al.*, 2008), but also to attentional biases (Xu *et al.*, 2015) and biased judgements (Smart Richman, Martin, & Guadagno, 2016). We hope that by providing a cognitive psychology framework, we will help readers form a more detailed understanding of the different phenomena involved in social information processing. We also hope it proves useful for researchers in designing studies on the effects of exclusion on specific social cognitive processes. After presenting the model, we will review the published research on the topic and discuss what we currently know about the effects of exclusion on social information processing. We will critically discuss some earlier propositions researchers have offered and highlight important unanswered questions that future research should investigate in order to get a clearer picture of how exclusion influences processing of social information.

A typical model of information processing

Stages of information processing

In Figure 1, we present a typical cognitive psychology model of information processing, which contains three separate stages: (1) perception, (2) cognitive and affective

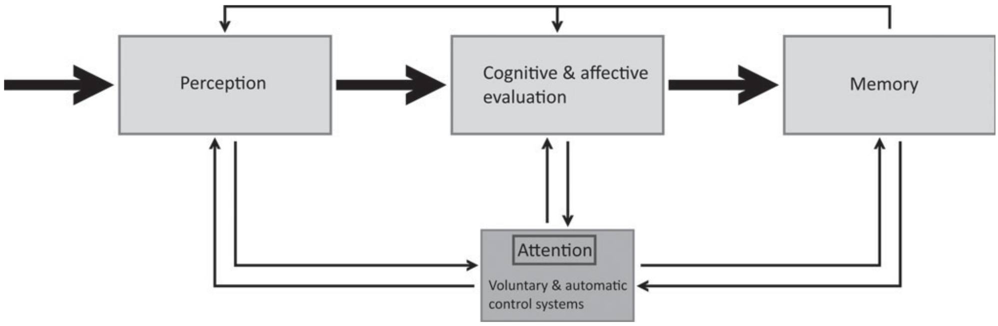

Figure 1. A model of information processing. The figure shows three stages, in which information is processed: perception, cognitive and affective evaluation, and memory. The figure also shows how these information processing stages interact with attention, and how memory influences earlier stages of processing. For more information, see the main text.

evaluation, and (3) (long-term) memory. *Perception* refers to a stage of processing after sensory information has been received by the perceiver's sensory organs. The information is processed in the brain regions specific for different sensory modalities. Information from some socially relevant categories of stimuli, such as faces, is processed in specialized neural systems (Haxby, Hoffman, & Gobbini, 2000). The result of this stage of processing is a subjectively experienced sensation, a *percept* (Firestone & Scholl, 2016). The perceptual stage can be further divided into two distinct phases. First, the perceiver *detects* a stimulus (determines that a stimulus is present; Merikle & Reingold, 1990) and then *identifies* it (determines what the stimulus is; Riesenhuber & Poggio, 2000).

After the stage of perception, the stimulus may undergo deeper *cognitive and affective evaluation*. During this stage, the perceiver makes inferences about the stimulus, while the stimulus may also evoke affective reactions in the individual. We refer to the resulting attributions, interpretations, and affects collectively as *judgements*. This broad definition encompasses a huge range of different types of processes, some of which are relatively fast and straightforward (e.g., judging someone's face as trustworthy), whereas others are slower and more complex, such as those requiring assessments of situational factors and cultural norms (e.g., judging someone as unlikable because of laughing inappropriately at a funeral). We also want to emphasize that judgements are not only shaped by high-level cognitive processes, but also different types of evaluative and affective reactions can be triggered before conscious judgements, and these automatic reactions can shape the conscious judgements (Murphy & Zajonc, 1993).

Finally, at the stage of *memory* processing, the information can be stored into long-term memory systems. The memory stage can be further divided into three separate sub-stages. First, at the *encoding* stage, the stimulus information is transferred to the memory systems, in which some of the encoded material is then *stored* at the second stage (Eichenbaum, 2017; Winters, Saksida, & Bussey, 2008). At the third sub-stage, the stored material can be *retrieved* from the memory for further use. Two distinct processes may be involved in memory retrieval (Yonelinas, 2002). In recognition, the contents of memory are matched to a cue (e.g., when asked whether a specific face was among previously shown faces), and in recall, the contents of memory are searched without a cue (e.g., when asked to list details from a previously read story).

Distinction between perceptions and judgements

We emphasize that we use the term perception to strictly refer to processes, which organize incoming sensory information in such a way that it is possible to mentally represent an external stimulus. These processes are distinct from evaluative processes that may follow perceptions. However, drawing a line between perceptions and judgements is not always straightforward. Researchers cannot measure perceptual phenomena directly, at least when relying on various behavioural measures. Thus, they often have to rely, for instance, on recognition performance, subjective ratings, or motor behaviour to infer what the participants perceive. The limitation of this approach is that these types of measurements are subject to influences of higher-level cognitive processes (Firestone & Scholl, 2015, 2016). Participants' responses may reflect not only their perceptions, but also their beliefs, motivations, expectations, and response styles. In other words, perceptual reports also reflect judgements instead of just 'pure' perceptions. For example, a facial expression can be judged as sad because of visually appearing sad, but also for other reasons: An objectively neutral face can be judged as sad when encountered at a funeral. Even in simple detection tasks, in which participants report whether they perceive a stimulus or not, the responses are influenced by the participants' response biases (Macmillan & Creelman, 1990). For instance, people may be more likely to indicate having detected a stimulus if missing a stimulus would be costly, as compared to a situation where detecting all stimuli is not that critical, for example, when spotting people on a warzone versus on a hiking trip.

It is difficult to determine where exactly the line between perception and judgements is (for discussion, see Pylyshyn, 1999), but importantly, there are ways to disentangle between the two. The SDT (Stanislaw & Todorov, 1999) allows researchers to discern participants' response biases from their discrimination accuracy using statistical methods. As for studies investigating subjective percepts, Firestone and Scholl (2016) offer guidelines on how perception could be distinguished from cognitive phenomena. We will not present the details here but will return to the issue later when discussing at which stage social exclusion exerts its influence.

The role of attention in information processing

Our senses are constantly flooded with a plethora of sensory information, and not all of this can be processed up to the higher stages. From the earliest perceptual stages, attention filters the information that will undergo further processing (Carrasco, 2011). Even detection does not happen without attention, as evidenced by studies showing that surprisingly salient events can go completely undetected when attention is focused elsewhere (Simons & Chabris, 1999). Also after detection, several stimuli often compete for attention, and attention determines which stimuli will pass further in the information processing pipeline.

Humans have two systems that control orienting of attention: endogenous (voluntary) and exogenous (involuntary or automatic) attentional systems (Carrasco, 2011; Corbetta & Shulman, 2002; Posner, 1980). In other words, individuals may direct their attention voluntarily, but sometimes, the focus of attention is determined by automatic, involuntary processes. For instance, suddenly appearing stimuli tend to automatically capture attention (Yantis & Hillstrom, 1994), and this response can be difficult or even impossible to suppress (Remington, Johnston, & Yantis, 1992). After automatic shifts of attention, attention can be voluntarily directed, but voluntary attention control mechanisms take longer than the automatic mechanisms to deploy (approximately 300 ms; Carrasco, 2011).

The characteristics of the perceived stimuli influence whether attention will be directed towards them or not. For instance, when participants are presented with several different stimuli simultaneously, they tend to shift their attention towards socially salient stimuli, such as faces, rather than towards non-social control stimuli (Langton, Law, Burton, & Schweinberger, 2008). After attention has been engaged by a specific stimulus, attention has to be disengaged from the stimulus if another stimulus demands attention. However, attention may be held more by some stimuli than others and disengagement may be delayed. For instance, individuals suffering from anxiety tend to have difficulties in disengaging attention from threatening cues, such as angry faces (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). The tendency to have one's attention shifted towards, or being held by a specific category of stimuli, is called an attentional bias (Todd, Cunningham, Anderson, & Thompson, 2012). Some of these biases, such as the tendency to direct attention to faces, are present even in neonates and are thus likely inherent (Goren, Sarty, & Wu, 1975). Others, such as the tendency to direct attention to emotional faces, may be learned, habitual responses related to emotion regulation (Todd *et al.*, 2012).

The role of memory in information processing

The contents of memory also have various influences on earlier stages of information processing. As mentioned above, memory influences attention, as attentional biases can reflect learned responses to specific types of stimuli (Todd *et al.*, 2012). Thus, previously stored information can potentially modulate information processing via attentional mechanisms. In addition, memory has direct influences on perceptual and evaluative processes, even at the earliest perceptual stages. For example, familiar stimuli (e.g., words) are more readily detected than unfamiliar stimuli (e.g., non-words; Merikle & Reingold, 1990). At later stages, the influence of memory is, of course, even more central. For instance, identification is, by definition, an act of matching the perceived stimulus with a memory representation. It is also clear that stored memory information can modulate cognitive and affective evaluations. For instance, previous experiences can influence a perceiver's inferences drawn from a stimulus and the affective responses evoked by the stimulus.

How does exclusion modulate social information processing?

Exclusion and memory

The idea that exclusion modulates social information processing was originally proposed based on a study reporting that rejection, compared to control manipulations, improved participants' memory for social diary entries and impaired memory for non-social entries in a surprise recall task (Gardner *et al.*, 2000; see also Hess & Pickett, 2010). A later study also reported that excluded participants, but not a control group, showed better recognition for previously learned in-group faces as compared to outgroup faces (Van Bavel, Swencionis, O'Connor, & Cunningham, 2012), suggesting that excluded individuals were particularly good at remembering faces of individuals most likely to offer them inclusion. Another group of researchers investigated whether exclusion would modulate the 'other-race effect', that is, the tendency to better recognize faces of individuals belonging to the same racial group as the perceiver, as compared to individuals from other racial groups (Bernstein, Sacco, Young, & Hugenberg, 2014). The researchers found that this effect was eliminated among participants who were first excluded by members of the racial outgroup, but not among control groups. The results of these studies suggested that excluded individuals show improved memory for social information, and especially for information that is particularly important for them.

However, the studies did not reveal how exclusion caused these effects on memory. In all of the studies, participants underwent a social exclusion manipulation, and then encoded the to-be-remembered material, and later retrieved the information from memory. Exclusion may have exerted its influence at any stage between the initial encoding of the information and retrieval of this material from the long-term memory. As we will discuss in the following sections, exclusion exerts its influence on various earlier information processing stages, and these effects could explain the memory effects as well. Changes at earlier processing stages can of course influence later stages: For instance, enhanced memory encoding would later allow more information to be retrieved from memory. When only retrieval is measured, it is difficult to determine whether observed differences between excluded and control participants are caused by changes in retrieval processes or in processes at any of the preceding stages.

While some of the findings reviewed above may be driven by changes at earlier processing stages, there is some basis to believe that exclusion could also influence memory processes specifically. In one study, participants learned and later retrieved (presumably non-social) information from text passages, and importantly, the researchers led participants to expect social exclusion either during the learning phase or during the memory retrieval phase (Baumeister, Twenge, & Nuss, 2002, Experiment 2). The results showed that expecting exclusion during the retrieval phase impaired memory retrieval, but expecting exclusion during the learning phase had no effect on later memory retrieval, suggesting that exclusion influenced memory retrieval, but not encoding of information into memory. Of course, a single finding from a study with a modest sample size should not be taken as conclusive evidence, but importantly, the study offers an interesting example of disentangling the effects of exclusion at different memory stages. Similar methods could be used in the future to investigate whether enhanced memory for social information is also driven by changes at memory retrieval processes, or at some earlier information processing stages.

Does exclusion modulate percepts or judgements?

Several studies have reported that exclusion caused individuals to view social information in an altered way. Some studies have found excluded participants to view others particularly positively and as promising sources of reinclusion. It has been shown that exclusion manipulations, compared to control conditions, caused participants to rate others as nicer, friendlier, and more attractive (Maner *et al.*, 2007, Experiments 3–4), to underestimate physical distance to potential affiliation partners, but not to objects (Knowles *et al.*, 2014; Pitts *et al.*, 2014), to evaluate inanimate faces as being more animate (Powers, Worsham, Freeman, Wheatley, & Heatherton, 2014), and to judge a wider range of averted gaze directions as being directed at them (Lyyra, Wirth, & Hietanen, 2017). Other studies have found an opposite pattern of results reporting that excluded participants viewed social stimuli particularly negatively, instead. Excluded participants, compared to control groups, rated ambiguous actions as more hostile (DeWall, Twenge, *et al.*, 2009, Experiments 2–4), were slower to judge faces as happy when the expression turned from neutral to a smile (Smart Richman *et al.*, 2016), and were biased to view others as portraying averted gaze (Syrjämäki, Lyyra, & Hietanen, 2018).

Now, it is important to note that, in all of the above-mentioned studies, the researchers were measuring participants' conscious judgements. Because these judgements occur late in the chain of stages involved in information processing, they could reflect changes at the level of evaluation, as well as at any of the previous stages. Maner *et al.* (2007) who found that exclusion, as compared to control manipulations, caused participants to rate others as nicer and more friendly, interpreted their finding to indicate 'the presence of motivated cognition (or wishful thinking)' (p. 52). In other words, they suggested that the effect might have occurred only at the level of judgements, as excluded participants started to rate social stimuli according to their own motivations. However, other researchers have argued that exclusion might exert its influence at an earlier stage, modulating percepts. For instance, Pitts *et al.* (2014) who reported that exclusion shortened the estimation of interpersonal distance suggested that exclusion made other people visually appear closer. Knowles *et al.* (2014) who reported convergent findings offered a similar interpretation, although they also acknowledged that the effect might have occurred at the level of judgements as well. Importantly, however, as we will discuss next, one of their experiments suggested that the manipulations might have altered distance judgements, and not necessarily visual perception of distance.

One way of providing support for the notion that an effect on judgements reflects changes at early, perceptual-level processing stages, is by demonstrating that the effect occurs specifically in tasks involving perceptual judgements. However, if similar effects are also observed for non-perceptual judgements, then it is possible that the effects occurred only at the level of judgements (Firestone & Scholl, 2015, 2016). Importantly, current evidence suggests that exclusion modulates non-perceptual and perceptual judgements in similar ways. For instance, altered estimations of interpersonal distance (Knowles *et al.*, 2014; Pitts *et al.*, 2014) also occur when participants do not see the target. In one experiment, Knowles *et al.* (2014, Experiment 1) asked participants to reflect on a time they had either been rejected or been accepted by another person. After this, participants estimated the distance to the city where the individual was currently residing. The results showed that participants estimated the distance to the accepting person as shorter (relative to the real distance) than the distance to the rejecting individual. Although this experiment does not reveal whether it was reliving the acceptance or rejection, or both, that influenced the distance estimations, it clearly shows that the relational status with another person can influence distance judgements, even when this effect cannot be due to altered perception. Thus, it was premature to conclude that exclusion causes potential reaffiliation partners to visually appear closer – they may only be judged closer (for a similar suggestion that physical effort influences distance judgements, but not perception, see Woods, Philbeck, & Danoff, 2009). Of course, we cannot rule out the possibility that exclusion also influences distance perception, but the simpler explanation that only distance judgements are affected is sufficient to explain the current findings.

Exclusion has also been found to alter other non-perceptual judgements. For instance, exclusion may cause individuals to rate contents of words and sentences as more hostile (DeWall, Twenge, *et al.*, 2009, Experiment 1). As these effects clearly do not reflect changes in participants' perceptions, it seems most plausible that altered judgements among excluded individuals reflect changes at high-level cognitive processes, rather than at the early perceptual-level processes. To find if exclusion also modulates percepts, future research needs to be extremely stringent in ruling out simpler, alternative explanations, such as that the observed effects reflect participants' thinking rather than perception (for guidelines, see Firestone & Scholl, 2016).

The altered judgements among excluded individuals likely reflect the affective states and motivational tendencies exclusion had aroused. DeWall, Twenge, *et al.* (2009) found that hostile judgements mediated the link between exclusion and aggressive behaviour (see also Dodge *et al.*, 2003). Excluded individuals may start to rate social stimuli according to their own motivations (Maner *et al.*, 2007) and affective states, and act accordingly. Theoretical models that describe the effects of exclusion on motivation (Smart Richman & Leary, 2009; Williams, 2007) might therefore offer a useful framework for understanding why excluded individuals sometimes judge social stimuli as positive and affiliative (Maner *et al.*, 2007), and sometimes as exclusive and threatening (DeWall, Twenge, *et al.*, 2009). To thoroughly understand this issue, future research should carefully investigate how different situational factors (Syrjämäki *et al.*, 2018), individual traits (Smart Richman *et al.*, 2016), and characteristics of the target stimuli (Brown, Sacco, & Medlin, 2019) moderate the effects of exclusion on judgements.

Future research should also investigate whether exclusion exerts effects, not only on controlled and conscious judgements, but also on automatic evaluative responses (Williams, Case, & Govan, 2003). The affective priming paradigm would provide one convenient way of investigating this question. In this type of task, participants are typically primed with affective stimuli, such as positive and negative faces, after which they judge the valence of non-affective stimuli. The primes can influence the following judgements, even when the primes are presented below the level of perceptual awareness, suggesting that the stimuli automatically trigger affective responses that cannot be attributed to higher-level cognitive processes (Li, Zinbarg, Boehm, & Paller, 2008; Murphy & Zajonc, 1993). If exclusion would enhance or otherwise modulate this effect, it would suggest that exclusion influences the affective responses automatically triggered by the affective social stimuli, rather than only altering judgements possibly reflecting changes in high-level cognitive processes.

Exclusion and early social information processing

One way of investigating whether exclusion exerts its influence at the early processing stages is by examining its effects on perceptual-level identification and detection tasks. Pickett, Gardner, and Knowles (2004) found that high reported need for belonging was associated with higher accuracy in identifying whether faces were portraying happy, angry, fearful, or sad expressions, and whether words were read in a positive or a negative tone (although no effect of an exclusion manipulation was found). In a later study, participants reflecting on rejection were more accurate than a control group in determining whether smiles were genuine or fake (Bernstein *et al.*, 2008). Another study showed that exclusion versus inclusion enhanced accuracy in distinguishing between faces belonging to two different categories (e.g., between a mildly happy and a mildly angry face), but reduced accuracy in discerning between faces within a category (e.g., between two happy faces varying in the intensity of the expression; Sacco *et al.*, 2011). An important contribution of this study was that it showed that exclusion did not influence acuity in distinguishing between non-social stimuli in a similar vein, suggesting that this effect was specific to processing of social information.

While little research has been conducted on the topic so far, initial evidence suggests that exclusion exerts its influence at an even earlier perceptual level, detection. One recent study suggested that sources of exclusion may be more readily detected than sources of inclusion, as in a binocular rivalry task, participants reported detecting the face of a person who had excluded them for a longer period than the face of the person who had included them (Golubickis *et al.*, 2017). Another recent study reported that in two experiments, excluded participants were less accurate than included participants in detecting whether vague videos contained human motion or not, suggesting that exclusion might impair detection of social stimuli (Gorman, Harber, Shiffrar, & Quigley, 2017). This is interesting, as earlier studies suggest that exclusion improves social stimulus identification (Bernstein *et al.*, 2008), that is, a process after detection. Of course, this still scarce body of evidence using various types of tasks and stimuli does not allow us to infer that exclusion modulates detection and identification differently, but this possibility might be worth investigating in the future. Detection and identification are partly separate, and driven by different neural mechanisms (Ungerleider & Haxby, 1994), and thus, exclusion might modulate these two processes differently. To widen our understanding on how exclusion influences performance in perceptual tasks, future research should investigate its effects on both detection and identification.

Because of its excellent temporal resolution, electroencephalography (EEG) is a useful method for investigating the earliest information processing stages. Kawamoto, Nittono, and Ura (2014) provided initial evidence that exclusion may modulate event-related potentials (ERPs) elicited by faces portraying different expressions (smiling, disgusted, and neutral faces were displayed). Excluded, but not included participants, showed greater P1 responses to disgusted faces, as compared to neutral faces. Although this finding is not conclusive, as the interaction was only approaching statistical significance, it, nevertheless, offers support for the notion that exclusion modulates face processing at the earliest perceptual stages. The visual P1 response is generated in the early visual cortical areas as early as 80–100 ms after stimulus presentation (Rossion & Caharel, 2011). Another interesting finding was that, while there was no effect of the manipulation on face-sensitive N170 responses, low self-reported satisfaction of basic social needs (Williams, 2007) was associated with a greater N170 response to all faces, providing initial evidence that individuals with unmet social needs might show enhanced processing of faces, in general.

Particularly, convincing evidence for the effects of exclusion on the early, perceptual processes comes from studies utilizing the SDT (Bernstein *et al.*, 2008; Gorman *et al.*, 2017; see also Müller, Jusyte, Trzebiatowski, Hautzinger, & Schönenberg, 2017). This approach is illuminating, as the SDT allows disentangling of participants' discrimination accuracy from their response styles and other similar biases. However, even these studies do not allow determining which mechanisms cause the altered detection and identification performance. The findings could reflect altered attention allocation among excluded participants (Pickett *et al.*, 2004). For instance, enhanced accuracy in facial expression recognition could result from excluded individuals maintaining their attention on the faces better than controls during the task (cf. Parasuraman, 1979), or from increased attention to specific features of the stimuli, such as the eye region (cf. Hall, Hutton, & Morgan, 2010). While this provides a plausible explanation for these findings, the effects have also been suggested to reflect changes in perceptual processes via mechanisms other than attention (Sacco *et al.*, 2011). The current evidence does not allow us to conclusively determine which explanation better accounts for the effects of exclusion on perceptual-level processes (for discussion on why this distinction is important, see Firestone & Scholl, 2016; Pylyshyn, 1999). The sole EEG study on this topic (Kawamoto *et al.*, 2014) also does not shed light into this question, as both ERP components investigated in that experiment, P1 and N170, are also modulated by attention (Holmes, Vuilleumier, & Eimer, 2003; Taylor, 2002).

Future research could resolve the issue with an experiment in which excluded and control participants would complete, for instance, a facial expression recognition task, while concurrently doing a task that either loads their attention or not (for a similar approach in other fields, see Cohen, Alvarez, & Nakayama, 2011; Do-Joon, Woodman, Widders, Marois, & Chun, 2004; see also Firestone & Scholl, 2016). The attentional load task could involve, for example, tracking of either fast-moving objects (high attentional load) or slow-moving objects (low attentional load). If improved accuracy in facial expression recognition among excluded participants is due to increased attention to the task or specific parts of the stimuli, a concurrent high attentional load should greatly diminish this effect, as there would not be excess attentional resources to be allocated to the facial expression recognition task. If, on the other hand, it reflects altered perceptual processing via some other mechanism, an attentional load should have little or no effect on the outcome.

Exclusion and attention

We have argued that attention likely mediates many of the effects of exclusion on social information processing, especially the effects that occur at early information processing stages. In this section, we will review research, which has more directly investigated the effects of exclusion on attention. We will look into several important questions. First, we will look at studies, which have examined towards which kinds of stimuli excluded individuals tend to allocate their attention. We will also discuss whether exclusion only changes how individuals allocate attention voluntarily, or if exclusion also modulates automatic, involuntary attentional processes (Carrasco, 2011). Finally, we will discuss whether the attentional biases that individuals show after experiencing social exclusion are driven by an inherent social monitoring system or if they reflect learned emotion regulation strategies.

Exclusion and attentional biases

Several researchers have argued that exclusion causes individuals to allocate more attention to social information (Pickett *et al.*, 2004; Shilling & Brown, 2016). Curiously, however, no experiment to date has actually provided firm evidence that this is the case. The idea was originally proposed based on a study, in which participants first reflected on a time they had been rejected, and then completed an affective Stroop task, in which they indicated the affective valence of meaning of words when the words were read aloud in a tone that was either congruent or incongruent with the semantic valence of the word (Pickett *et al.*, 2004; Experiment 2). In this study, the difference in response times between congruent and incongruent trials was larger among participants who had reflected on rejection, as compared to control groups. The authors interpreted that exclusion caused participants to pay more attention to vocal tones, making it more difficult to ignore this socially salient information. However, it is not clear whether this effect reflects selective attention to social information specifically. An alternative explanation is that exclusion impaired participants' ability to voluntarily direct their attention as instructed, and thus magnifying the Stroop effect (Baumeister, DeWall, Ciarocco, & Twenge, 2005). In addition, even if the increased Stroop effect did reflect excluded participants' increased attention to the vocal tones, it does not show that exclusion increased attention to social information specifically, as there was no control task showing that exclusion did not increase attention to non-social information.

To investigate whether exclusion increases attention to social information, a future experiment could, for instance, have social and non-social stimuli compete for participants' attention in a dot-probe task (MacLeod, Mathews, & Tata, 1986), and examine whether exclusion, as compared to control manipulations, increases participants' tendency to direct attention towards the social stimuli. Alternatively, a study could test if excluded participants, as compared to controls, are slower in disengaging attention (Fox, Russo, Bowles, & Dutton, 2001) from social stimuli, but not from non-social stimuli. These studies could potentially show that exclusion causes individuals to allocate more attention to social stimuli specifically.

An interesting line of research relates to whether excluded individuals preferentially direct attention towards specific categories of social stimuli. For example, several studies have shown that being excluded elicits attentional biases to positive cues. DeWall, Maner, & Rouby, (2009) found that excluded participants, compared to controls, looked longer at a smiling face in an array of emotional faces (Experiments 2–3; see also Buckner, DeWall, Schmidt, & Maner, 2010; see Figure 2a for an illustration and explanation of the task). In a dot-probe task, exclusion has been shown to increase participants' tendency to shift attention towards smiling rather than neutral faces (Experiment 4; see Figure 2b). Similarly, excluded individuals may also direct attention away from negative social information. One study found that participants expecting exclusion, as compared to participants expecting inclusion, showed less activity in the dorsomedial prefrontal cortex (dmPFC) when viewing pictures of negative social scenes (Powers, Wagner, Norris, & Heatherton, 2013; but see Powers & Heatherton, 2013). As dmPFC activation is associated with mentalizing, the authors suggested that excluded individuals engaged less than included participants in the in-depth processing of the contents of the negative social scenes, possibly by diverting attention away from these pictures (however, see Kraines, Kelberer, & Wells, 2018, for a recent finding that exclusion increased fixations on sad faces).

Interestingly, exclusion may not influence only voluntary control of attention, but also involuntary shifts of attention. Xu *et al.* (2015, Experiments 2–3) found that excluded, but not included, participants showed an attentional bias to smiling faces as early as 200 ms after presenting the stimuli in a dot-probe task. This is interesting, as people may be unable to voluntarily shift the locus of attention this fast (Johnson, 2009). This could suggest that excluded individuals reflexively direct their attention towards smiling faces, although a finding from a single study should of course not be taken as conclusive. Offering support for the view, however, one experiment found that excluded participants were faster than controls at finding a smiling face, but not other emotional faces in a visual search task (DeWall, Maner, & Rouby, 2009, Experiment 1; see Figure 2c). However, it should be noted that it is not possible to determine whether, in this study, the smiling faces attracted the excluded participants' attention towards them, or whether these participants were particularly efficient in performing serial search for smiling faces, due to spending less time looking at each face. A future study could investigate this question by varying the number of displayed distractor stimuli across trials. If excluded participants' attention is automatically shifted towards the smiling face, the number of distractor stimuli should have little effect on the response times, whereas if they perform serial search for the smiling face, the increased number of distractors should slow down the response times, as there would be more faces to go through (Wolfe, 1994).

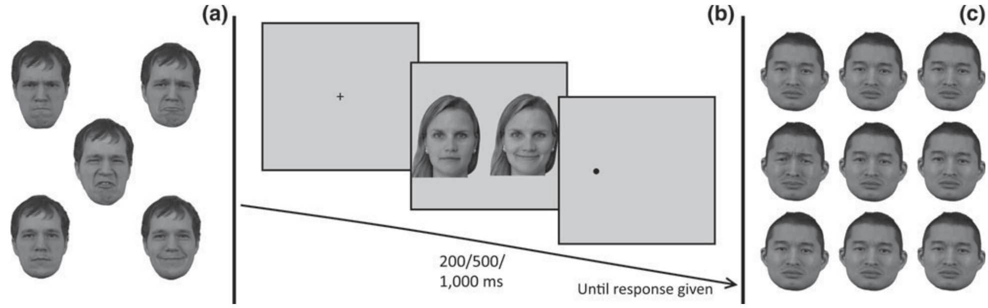

Figure 2. Illustrations of three tasks used to measure attentional biases. (a) Eye tracking methods (Buckner *et al.*, 2010; Kraines *et al.*, 2018). Participants are simultaneously presented with several different stimuli, such as faces with different facial expressions. They are instructed to view them freely, while their eye movements are measured with an eye tracker. Increased dwell times or fixations to a specific category of stimuli indicate selective attention to that category. Because the stimulus presentation times are typically long (e.g., 30 s at a time), this method is useful for investigating participants' voluntary attentional processes. (b) Dot-probe task (DeWall, Maner, & Rouby, 2009, Experiment 4; Tanaka & Ikegami, 2015). Participants are presented with two stimuli (e.g., a neutral face and a smiling face) simultaneously. After a delay, one of the stimuli is replaced by a probe and the participants are instructed to detect the probe as quickly as possible by pressing a response key. The effects of different stimuli on participants' attention can be assessed by comparing the reaction times in the different types of trials. For instance, if reaction times are shorter for trials in which the probe was presented at the location of a smiling face, as compared to a neutral face, this indicates that the smiling face had 'pulled' the participants' attention towards it. The length of the time between presenting the face and the probe (stimulus-onset-asynchrony, SOA) can be manipulated to investigate the time-course of the attentional biases. By using short SOAs (e.g., 200 ms), researchers can investigate early, reflexive shifts in attention, while longer SOAs (e.g., 1,000 ms) can be used to investigate the voluntary control of attention. As a caveat, the dot-probe paradigm has been criticized for low reliability (Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). (c) Visual search task (DeWall, Maner, & Rouby, 2009, Experiment 1; Tuscherer *et al.*, 2015, Experiment 4). In this task, researchers typically measure the time participants take to locate a target stimulus (e.g., a face showing an emotional expression) from a set of distractor stimuli (e.g., neutral faces). Performance in visual search is influenced by various factors, such as the capacity of the target stimulus to attract attention among the distractor stimuli, the number of distractors present, and individuals' performance strategies, among other things (for a review, see Eckstein, 2011).

There is also some evidence that exclusion may cause individuals to shift their attention towards negative rather than positive faces. In one experiment employing a visual search task, participants who had imagined unfair exclusion were faster than other experimental groups in locating an angry face, but not in locating a smiling face, suggesting that these participants' attention shifted towards angry faces, or the participants were particularly efficient in searching for angry faces (Tuscherer *et al.*, 2015, Experiment 4). In another study, Tanaka and Ikegami (2015) found one boundary condition for when exclusion causes individuals to shift attention towards positive and negative faces. In their study, excluded participants high in fear of negative evaluation (FNE; a component of social anxiety) showed an attentional bias to angry faces in a dot-probe task, while excluded participants low in FNE showed an attentional bias to smiling faces. This may indicate that individuals low in social anxiety shift their attention to smiling faces as a response to exclusion, while anxious individuals tend to direct attention to signs of social threat (but see Buckner *et al.*, 2010, for a different interpretation).

Inherent or learned responses?

One vital question is whether the attentional biases that excluded individuals show are inherent, biologically determined responses, or if they are learned. According to the social monitoring system hypothesis, humans have a specialized system that directs attention to social information when belonging needs are unmet (Pickett & Gardner, 2005). This system has been suggested to be an evolutionary adaptation that helped our ancestors to maintain social bonds, which is essential for survival and reproduction (Gardner *et al.*, 2000).

An alternative possibility is that the attentional biases reflect the individuals' learned styles of responding to exclusion. Todd *et al.* (2012) proposed that attentional biases are one form of emotion regulation, and they reflect individuals' habitual responses to different emotional stimuli and affectively salient events. As social exclusion is a common occurrence for many (Nezlek, Wesselmann, Wheeler, & Williams, 2012), most people have learned various ways of coping with this adverse experience. As a part of these learned coping responses, individuals might direct their attention towards specific kinds of social and affective stimuli to help them navigate social environments more efficiently, and to help them regulate their own affective state. For instance, they might attend to threat cues to identify signs of threat and avoid further exclusion (cf. Cacioppo & Hawkley, 2009). Attending to affiliative cues might help them pick out the most likely sources of reinclusion (DeWall, Maner, & Rouby, 2009), or attenuate the negative feelings elicited by exclusion (Xu *et al.*, 2015; although see Syrjämäki, Lyyra, Peltola, & Hietanen, 2017). Individual differences and situational factors might determine which coping strategies individuals utilize as a response to different kinds of exclusion experiences, explaining why exclusion influences attention differently in different individuals (Tanaka & Ikegami, 2015; Tuscherer *et al.*, 2015).

We cannot currently determine whether specialized neural and psychological mechanisms mediate the effects of exclusion on attention to social information. Considering how influential the social monitoring system hypothesis has been, it would be important to stringently test its predictions. Crucially, future research should determine whether the attentional biases that individuals show as a response to exclusion are specific to social stimuli. Limited evidence suggests that this might not be the case. DeWall *et al.* (2011, Experiment 6) found that excluded participants were slower than control groups at disengaging attention from positive affective words, but not from neutral or negative words. This finding suggests that exclusion increases allocation of attention to affective stimuli generally, regardless of whether these stimuli are social or not.

Future research should also investigate the neural basis of the hypothesized social monitoring system. Previous research has identified brain regions, including the amygdala and specific structures of the prefrontal cortex that play a role in attentional biases (Cisler & Koster, 2010; Todd *et al.*, 2012). If the effects of exclusion on attention operate via a social monitoring system, then there might be neural mechanisms, whose activity is specifically associated with attentional biases caused by social exclusion. Importantly, activity in these mechanisms should be uncorrelated with other types of attentional biases, such as those attributed to post-traumatic stress disorder (Bar-Haim *et al.*, 2007) or to attentional bias modification training interventions (Hakamata *et al.*, 2010). These hypotheses could be investigated in future research to determine whether the effects of exclusion on attention are due to activation of a social monitoring system.

Conclusion

Attention has widespread influences on various stages of information processing, and thus, research on the effects of exclusion on attention is particularly important. The currently published research has largely focused on finding which types of stimuli socially excluded individuals tend to direct attention towards. Future research could provide further insight into how exclusion influences different attentional control mechanisms, such as voluntary and involuntary attentional systems (Corbetta & Shulman, 2002). Furthermore, future research should investigate whether specialized social monitoring mechanisms mediate the effects of exclusion on attention, as has been argued by researchers in this field (Pickett & Gardner, 2005).

Concluding remarks

The research reviewed in this article shows that exclusion influences social information processing in various ways. However, there are also gaps in our understanding on this issue, and some of the conclusions previously drawn from these studies are not firmly supported by the empirical evidence. Future research would benefit from paying close attention to the specific mechanisms and information processing stages where exclusion exerts its effects. Researchers should directly investigate which mechanisms mediate the previously reported effects of exclusion on, for instance, memory performance, facial expression recognition, and perceptual judgements. In a similar vein, future research making strong claims about the processes where exclusion exerted its effects should include control conditions, which show that the effects occurred at those processes specifically. For instance, if concluding that exclusion altered perceptual stage processes, it is vital to show that the observed effects actually reflect changes specifically in perceptions, and not in attention allocation, or higher-level judgements. Of course, we are not suggesting that all studies need to pinpoint the processes where the effects occurred, as it is secondary to the main goals of many studies. In such cases, it is simply sufficient to avoid making far-reaching conclusions about these mechanisms, and to acknowledge alternative explanations for the findings.

We conclude by emphasizing that research on social information processing is important. Biases in information processing predict aggressive behaviour (Dodge *et al.*, 2003) and even play an important role in aetiology of various problems, such as loneliness (Cacioppo & Hawkley, 2009), depression (Leppänen, 2006), and anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Understanding how these biases emerge in socially excluded individuals might help researchers to better understand why exclusion sometimes leads to detrimental outcomes, and why some individuals are able to respond to exclusion adaptively and restore their sense of belonging. Future research should provide further understanding into how exclusion alters social information processing, and clarify the psychological and neural mechanisms that drive these effects. This would not only illuminate this interesting question, but might hypothetically also provide a basis on which to develop interventions to mitigate the adverse effects of social exclusion.

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